Strengthening innovation-driven inclusive and sustainable development

Asia-Pacific Tech Monitor

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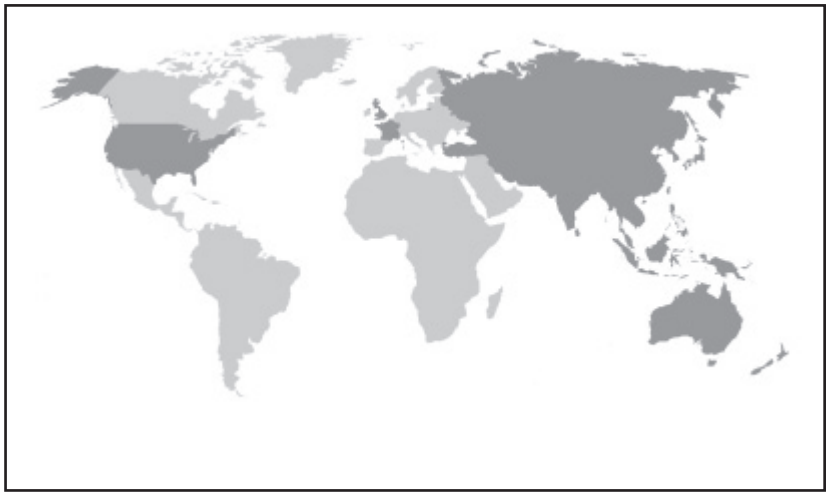
APCTT
Asian and Pacific Centre for Transfer of Technology

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

The **Asian and Pacific Centre for Transfer of Technology** (APCTT), a subsidiary body of ESCAP, was established on 16 July 1977 with the objectives to: assist the members and associate members of ESCAP through strengthening their capabilities to develop and manage national innovation systems; develop, transfer, adapt and apply technology; improve the terms of transfer of technology; and identify and promote the development and transfer of technologies relevant to the region.

The Centre will achieve the above objectives by undertaking such functions as:

- Research and analysis of trends, conditions and opportunities;
- Advisory services;
- Dissemination of information and good practices;
- Networking and partnership with international organizations and key stakeholders; and
- Training of national personnel, particularly national scientists and policy analysts.



The shaded areas of the map indicate ESCAP members and associate members

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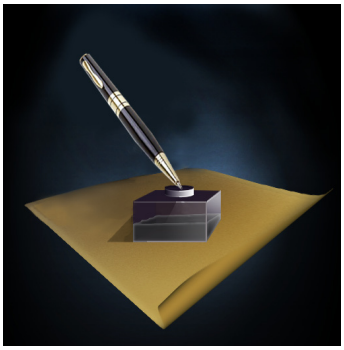


Introductory note

Science Technology and Innovation (STI) is being considered by the global community as an important vehicle towards achieving post 2015 Sustainable Development Goals. The recent decades have seen evolution and adoption of diverse policy strategies across the world to harness the benefits of STI, particularly in the areas of new and emerging technologies. As a result, many countries have been successful in achieving rapid growth of "knowledge-based enterprises" thereby contributing immensely to their economic growth in the recent times. Towards this endeavor, 'Smart Specialization' is being increasingly used as an effective STI strategy in the developed countries of Europe and America.

It is common belief that when investments are spread too thinly across several frontier technology areas with limited resources, the impact in any particular area would be substantially diluted. Smart specialization approach addresses this issue by helping countries or regions to identify and select a limited number of priority areas for knowledge-based investments, focusing on their strengths, weaknesses, market developments, emerging opportunities, and potential areas of excellence relative to other regions. The strategy, therefore, needs to be built on a sound analysis of regional assets and technological capacity and should be based on strong partnerships between businesses, public entities and knowledge institutions. The ultimate goal is to achieve economic prosperity by enabling regions to focus on their respective strengths.

The Asia Pacific region presents widespread diversity in terms of technological, industrial and economic development and the countries cannot afford to spread their limited resources and investments across too many sectors thereby resulting in limited impacts. It is therefore imperative for countries to adopt more focused STI strategies for developing identified regions based on their strength, capacity and investment that may be necessary. In this context, the smart specialization approach could offer wide opportunities to the national governments to design and deploy appropriate STI policy frameworks and instruments for promoting innovation and to generate competitive advantage for stakeholders in any particular region. If suitably designed and adapted to local conditions and needs, the strategy could be employed to strengthen national innovation systems of countries in the region. This in turn would help countries to facilitate the efficient and effective use of public investments for STI-driven economic development.

This issue of *Asia-Pacific Tech Monitor* discusses the challenges, opportunities and strategies for using smart specialization to design appropriate STI policy frameworks and institutional support mechanisms as per national development goals. The special issue presents several developed country experiences, case studies and best practices in using the smart specialisation strategy for technological, industrial and economic development.

Nagesh Kumar
Officer-in-Charge, APCTT-ESCAP

Technology Market Scan

ASIA-PACIFIC

BANGLADESH

Tax breaks for developers, investors of hi-tech parks

The National Board of Revenue (NBR) has offered a tax waiver for investors in hi-tech parks in an effort to promote investment and youth employment. Under the scheme, investors in the parks will get full tax breaks for the first 3 years of their operations, after which the benefit will gradually decline to be fully phased out in the 11th year. The developers of the parks will also get full tax breaks for 10 years from the beginning of the operation of the hi-tech parks, an NBR official said.

The tax authority announced the incentives a month after Finance Minister AMA Muhith in his budget speech shared the government's plan to provide special packages to encourage investment in developing economic zones and hi-tech parks along with investment in these areas.

Bangladesh Hi-Tech Park Authority (BHPA) has approved six parks, with work on Kaliakoir and Jessore projects already in progress. There are plans to facilitate establishment of 12 more parks in several districts to promote development of information technology (IT) and information technology-enabled service (ITES) industries, both of which are still at their nascent stages. The parks are expected to create nearly 10 lakh jobs and increase the present export earnings of $122 million manifold, according to government estimates. The government predicts that export receipts from IT services may touch the $1 billion-mark by 2018.

In a notice, the NBR said the benefits will be given to those that will be declared as parks under the Bangladesh Hi-Tech Park Authority Act 2010. Under the scheme, investors in the hi-tech park will get 80% tax waiver on their incomes from services or production in the fourth year of operation. The exemption will gradually decline by 10% points each year until the 10th year when a % tax break will be applicable. The developers will get 70% tax waiver on the 11th year and 30% on the 12th year. The benefit will be over in the 13th year, said an NBR official.

http://www.thedailystar.net

CHINA

Innovation to contribute up to 50% of GDP by 2025

China's innovation moves are expected to contribute 35–50% of total GDP growth from 2015 to 2025 with a number of supporting policies announced to boost entrepreneurial companies, a latest study by consultancy firm McKinsey Co said. Innovation will play an increasingly important role in addressing China's economic challenges including aging population and declining return on fixed investment, McKinsey Global Institute said in a research report. In the past 5 years, innovation contributed 30% of China GDP growth, according to McKinsey Global Institute's analysis.

China has unique advantage and capability in the customer-focused innovation and efficiency-driven innovation is already a top global competitor. "China's massive and dynamic domestic market as well as a positive mechanism to allow market players to and receive feedback has created a favorable environment for innovation," said Chen Yougang, McKinsey partner and head of McKinsey Global Institute. China will see more diversified innovation formats with continuous market-oriented reforms in recent years have laid a solid foundation, Chen noted.

However, innovation in the scientific research sector in China is still lagging behind as a result of lacking of a healthy ecological system, with the quality of output from the scientific innovations does not match the quantity of funding. "Continued reform, particularly in state-owned enterprises, can help enable more innovation," senior partner and director of McKinsey Global Institute Jonathan Woetzel added.

Multinational companies also should leverage these capabilities to enhance their global competitiveness by investing more in their local research and development (R&D) facilities, the study pointed out.

http://www.shanghaidaily.com

Technology transfer centers to be set up with ASEAN countries

China and Indonesia have established a technology transfer center in southwest China's Guangxi Zhuang Autonomous Region, the fifth between China and the Association of Southeast Asian Nations (ASEAN). China established transfer centers with Cambodia, Myanmar, Laos and Thailand in 2014.

"We are actively promoting the construction of such centers with more member states of the association," said Liu Jianhong, deputy director of the regional department of science and technology. Liu said the cooperation arrangements with Malaysia and Viet Nam have been going smoothly.

A total of 1,228 companies, research institutions and industry associations in the fields such as agriculture and renewable energy have joined the China-ASEAN Technology Transfer Center (CATTC) since its establishment in 2013. A CATTC forum on collaborative innovation will be held in Nanning, capital of Guangxi, this September 2015.

http://www.shanghaidaily.com

INDIA

Innovation solutions

In order to leverage Indian creativity, expertise, and resources to identify and scale innovative solutions, the Federalies of Indian Chamber of Common Industry (FICCI) and the World Bank on Monday announced their partnership to advance the Millennium Alliance (MA) initiative. "The MA is an inclusive platform to leverage Indian creativity, expertise, and resources to identify and scale innovative solutions being developed and tested in India to address development challenges that will benefit base of the pyramid populations across India and the world," an official statement said.

The agreement was signed by FICCI secretary general A. Didar Singh and World Bank country director Onno Ruhl to formalize a shared commitment to support sustainable and scalable innovative solutions in the identified priority areas of sanitation, education, and healthcare, clean energy, and agriculture.

The World Bank and the Federation of Indian Chambers of Commerce and Industry have come together in a knowledge partnership to support the development of the social enterprise sector in India, and to promote replication and scale of the social enterprise innovations across the South Asia and Africa regions.

The MA was launched in July 2012 jointly by the Technology Development Board, United States Agency for International Development and FICCI to recognize India's role as a global innovation laboratory, by identifying, testing, and scaling solutions that leverage private and public sector resources and expertise to reduce the cost and increase the reach of development improvements in India and around the world.

http://www.siliconindia.com

Pharma outsourcing

The pharmaceutical outsourcing market (excluding contract manufacturing services) accounts for almost 75% of the estimated $3.3–4.2 billion medical process outsourcing (MPO) segment in India, a survey has said. According to an Assocham-EY joint study, the pharmaceutical outsourcing market currently stands at $2.5–3.1 billion. "While the payer outsourcing market constitutes $700–900 million of India's MPO market, the provider market accounts for the remaining share of ~$100–200 million," the study titled 'Medical Process Outsourcing in India' said.

Domestic players are gradually moving up the value chain in terms of service offerings while maintaining their cost competitiveness, it said. "The payer BPO market is likely to grow at ~10% year-on-year in the next 3–4 years globally, provider outsourcing at > 30% during 2011–2016, and the Contract Research Organisations (CROs) market at 18–20% in the coming years," the study pointed out.

The rising demand for high-end healthcare facilities and multispecialty hospitals, established medical and central lab infrastructure and training centers is contributing to the growth of healthcare and life sciences industry thereby fueling the domestic demand for medical process outsourcing, it added. The research suggested that the Government should focus on implementing data privacy laws, introducing proper regulations around intellectual property and patent laws, among others. The challenges around privacy laws, intellectual property laws, and changing clinical trial laws continue to exist.

http://www.thehindubusinessline.com

MALAYSIA

National IoT roadmap unveiled

The Ministry of Science, Technology and Innovation and its applied research agency, MIMOS, launched the National Internet of Things (IoT) Strategic Roadmap, a document that would serve as a guideline for IoT implementation in Malaysia. "IoT implementation goes across key social and economic sectors. This means that the development and implementation of IoT require a clear guideline and strategy that takes into account various critical aspects such as data security and sovereignty, privacy, Intellectual Property management etc," Minister Datuk Dr Ewon Ebin said at the launch of the roadmap in Cyberjaya.

IoT implementation in Malaysia is expected to contribute RM9.5 billion to the country's Gross National Income (GNI) by the year 2020 and RM42.5 billion by 2025, according to the Minister. It is also projected to generate a total of 14,270 high-skilled employment opportunities by 2020. Dr. Ewon cited the country's creative and high-potential talent groups, good investment climate, as well as strong interest and commitment as key drivers in the country's push to become a regional IoT hub. MIMOS and Cyberview Sdn Bhd, CyberSecurity Malaysia and SAS Inc. also signed agreements, respectively, on developing Cyberjaya as a model 'Smart and Safe City' through IoT implementation.

Under the plan, Cyberjaya will implement various IoT-based solutions such as smart traffic management system and public safety monitoring, energy management, among many others, which can be enhanced and rolled out at a larger scale in due time.

http://enterpriseinnovation.net

Private financing for R&D, commercialization

The Malaysian government has earmarked efforts to promote private financing for R&D, commercialization and innovation (R&D&C&I), under a strategy to translate innovations into wealth in the country.

The efforts include increasing access to private sources of financing, developing a framework for risk mitigation and management of crowd funding activities, the 11th Malaysia Plan revealed.

"Access to financing and assistance will be strengthened through continuous engagement with private financial institutions, venture capitalists, and angel investors to widen financial options, reduce dependency on government resources, and increase the financing of R&D&C&I projects." This includes the expansion of the Technology Park Malaysia Angel Chapter and early stage financing for SMEs through the SIP program.

"In addition, equity crowd funding will be explored to widen the range of fundraising and investment products, as well as improve market access to a broader spectrum of issuers and investors," the plan noted. The plan added that crowd funding will be promoted to provide financing opportunities for SMEs, start-ups, and innovative businesses seeking liquidity in a more efficient and transparent manner.

The Malaysian Securities Commission has been pushing for the legislation of equity crowd funding since 2014. As of the latest updates, the parliament has yet to table the bill. "The Eleventh Plan will focus on strengthening relational capital by improving collaboration among all stakeholders. Innovation will be targeted at both the enterprise and societal levels, instead of previous efforts which focused primarily on national-level initiatives," the plan stated. At the enterprise level, initiatives will enhance demand-driven research, improve collaboration between researchers and industries, and encourage private investment in R&D&C&I.

The government will also look into a social finance model for public–private partnership programs to be introduced

to promote investments from the private sector, foundations, and individuals in delivering social services.

Through this model, the "payment by results" mode will be introduced, where private social impact investors will provide funding for NGOs and CBOs to implement social services and will be reimbursed by the government when the agreed outcomes are achieved. This model will reduce the burden and risk of social services programs through the sharing of resources and leveraging civil society's collective skills, enthusiasm, and innovation capacity with the government as a facilitator.

http://www.dealstreetasia.com

PHILIPPINES

Innovation center to be set up

The Philippines has announced a plan to build a national innovation center – taking cue from Silicon Valley in the United States, Block 71 in Singapore, and MaGIC in Malaysia. Government agencies, including the Department of Science and Technology (DOST) and the Department of Trade and Industry (DTI), are collaborating with startup accelerator IdeaSpace for this effort.

With initial funding of PHP 30 million (US$665,000) from the government and counterpart funding of up to PHP 15 million (US$332,000) from private sector and academe, the innovation center will have two locations – both of which will be near the country's premier universities.

The Philippine innovation center will foster technology advancement and startup ecosystem growth. Valencia said the hubs will be set up near key academic institutions to imbibe the spirit of innovative and entrepreneurial thinking among students, to tap into a wellspring of engineering and technology talent from these universities, as well as to address the growing interest of students in founding their own startups.

The center will also serve as a venue for government agencies and academic institutions to promote products, facilitate transfer of their R&D results, and establish connections with the investment community. The creation of the innovation hub will be a critical component in boosting the Philippines' ranking in the Digital Evolution Index (DEI), which ranks countries in terms of their readiness for the quickly expanding digital economy.

https://www.techinasia.com

R&D facility for electronics

The Department of Science and Technology (DOST) opened a facility to help propel the local electronics industry from assembly-centric enterprises to an innovation-oriented sector. The P268-million Electronics Product Development Center or EPDC provides businessmen and the academe equipment for electronics design, prototyping, and testing facilities, primarily printed circuit boards. The most expensive equipment in the building is the P160-million Electromagnetic Compatibility and Safety Test Facility, a cavernous room that allows testing of radio frequencies and signals in a controlled setting.

DOST is aiming for the electronics industry to upgrade from being largely an assembler and manufacturer of foreign products toward development of original product design. Electronics corner about half of the country's total export earnings, which is a major bulwark of our gross domestic product. Last year, the industry generated $25.8 billion in revenues, and expects to hit $27.6 billion this year. The EPDC was funded by the DOST-Philippine Council for Industry, and Emerging Technology Research and Development.

http://www.interaksyon.com

REPUBLIC OF KOREA

R&D investment up 4.3% last year

According to the numbers, the investments of the Republic of Korean government last year amounted to 17.64 trillion won (US$15.52 billion). The figure was up 4.3% from 16.91 trillion won (US$14.88 billion) a year ago. This is largely because of the increase in research support to provinces and small and medium-sized firms. The Ministry of Science, ICT and Future Planning (MSIP) announced on July 8 that it surveyed and analyzed the current state of 605 R&D projects, which were carried out by 33 government agencies last year, in a report called "2014 National Research & Development Business Survey and Analysis Result" at the Government Complex Sejong on July 7.

According to the report, five government ministries have invested nearly 14 trillion won (US$12.31 billion) last year – 6 trillion won (US$5.28 billion) from MSIP, 3.2 trillion won (US$2.82 billion) from the Ministry of Trade, Industry and Energy, 2.3 trillion won (US$2.02 billion) from the Defense Acquisition Program Administration, 1.6 trillion won (US$1.41 billion) from the Ministry of Education, and 900 billion won (US$791.77 million) from the Small and Medium Business Administration.

Research expenses for each project decreased 0.8% to 330 million won (US$290,314) year-on-year. For support by subject conducting studies, institutions came in first with 7.5 trillion won (US$6.6 billion) and 42.6%, universities in second with 4.1 trillion won (US$3.61 billion) and 23.3%, smaller companies in third with 2.4 trillion won (US$2.11 billion) and 13.7%, national research institutions in fourth with 900 billion won (US$791.77 million) and 5%, large companies in fifth with 700 billion won (US$615.82 million) and 3.9%, and mid-sized firms in sixth with 500 billion won (US$439.87 million) and 3.1%. By the phase of R&D, development research ranked first with 5.1 trillion won (US$4.49 billion), while the ratio of basic research also continuously increased to 36.3% with 4.5 trillion won (US$3.96 billion).

http://www.businesskorea.co.kr

12.638 trillion won to be invested in R&D

The government has decided to invest 12.638 trillion won (US$11.18 billion) in the nation's R&D projects next year. The figure is a 2.3% decrease from 12.935 trillion won (US$11.45 billion) this year. Despite a smaller budget in total R&D, the government said that it will increase investment in the disaster and safety sector by 11.2% from this year, and also increase budget for small- and medium-sized companies by 1.4%, strengthening "selection and concentration" in the R&D sector.

The Ministry of Science ICT, and Future Planning (MSIP) announced that its "2016 Government R&D Project Budget Allocation and Arrangement" was reviewed and confirmed during the 9th National Science and Technology Council presided over by Prime Minister Hwang Kyo-ahn and Co-chairman Lee Jang-moo at the Government Complex Seoul on July 10.

It is a budget bill for 373 major R&D projects of 19 governmental departments among the nation's R&D projects next year, excluding national defense, humanities, and social science.

In a bid to strengthen the technology innovation capabilities of small- and medium-sized companies, the government has decided to expand R&D in the sector. It will increase the support to 1.3821 trillion won (US$1.22 billion) and inject 102.4 billion won (US$90.61 million) into "smart manufacturing," that integrates information communication technology (ICT) and a whole production process of small and medium-sized companies.

http://www.businesskorea.co.kr

SRI LANKA

Innovation and technological adoption

Despite that innovation is becoming an important policy agenda for Sri Lanka, the country lags far behind its South Asian neighbors in innovation and technological adoption, a recently released report of the Asia Development Bank (ADB) said. The Global Competitiveness Index of the World Economic Forum ranks Sri Lanka behind other countries in university–industry collaboration in R&D, Patent Cooperation Treaty patents and applications, corporate R&D spending, and the quality of science research institutions.

Sri Lanka's spending on R&D equaled 0.16% of GDP in 2010 which is low even compared with its South Asian neighbors, with India at 0.81% in 2011, Pakistan at 0.33% in 2011, and Nepal at 0.30% in 2010, the Asian Development Bank's flagship annual economic publication, Asian Development Outlook 2015 (ADO), released Tuesday noted. Sri Lanka's component of high-tech products in total manufactured exports was 0.9% in 2012, far below the 6.2% average for South Asia, 8.4% for lower-middle-income economies, and 20.6% for upper-middle-income countries.

The Asian lender pointed out the need to encourage the private investment in R&D by removing institutional and regulatory bottlenecks and improving infrastructure, including those pertaining to information and communication technology.

"The environment for innovation could be improved by establishing proof-of-concept labs and patent-application grants, innovation voucher schemes and incentives for collaboration between firms and universities, and investment in knowledge-based capital supported by copyrights, trademarks, and brand equity," the ADB said in its ADO for this year. These initiatives may create multiple innovation bases and hubs, it said.

"Innovation cannot depend solely on large companies within structured systems. As the important role of frugal innovation is increasingly recognized, frugal innovation for consumers in the middle of the pyramid should be encouraged."

The ADB report suggested that the government should aim to raise R&D expenditure to at least 1.5% of GDP and concentrate public funds on innovation in a few high-impact areas. According to the ADB report, Sri Lanka's universities and research labs are not well linked with industry as is the case in many developed and emerging economies. Such links should be strengthened, the report said, pointing out that it was done successfully with the establishment of the nanotechnology park near Colombo, which secured five patents in its first full year of operation.

Sri Lanka has started to build up a pool of experts by gearing the education system to produce high quality science and technology graduates, the ADB noted. The proportion of students currently studying science subjects is low, as ~30% prefer the arts. Reform to secondary education to improve curricula and teaching quality should continue to be the government's focus, but the university system also needs quality improvement, the report concluded.

http://www.colombopage.com

THAILAND

Exim Bank launches credit products to support SMEs

Export-Import Bank of Thailand has witnessed well-placed incubator programs that have resulted in an emerging pool of entrepreneurs who are ready to export provided that sufficient funds are made available, said the bank's acting president, Suthanai Prasertsan. To that end, Exim Bank is prepared to extend credit facilities to novice small- and medium-sized enterprises that are interested in starting up an export business and have undergone government exporter-training programs or are experienced SMEs aspiring to become exporters.

The bank has launched a new "SME Start-up Credit" service to support SME exporters that have obtained purchase orders but lack working capital, with a credit limit of Bt2 million per exporter. Moreover, Exim Bank has introduced the "SMEs R&D and Innovation Credit" product with a maximum credit line of Bt5 million per business operator. This facility is designed to promote R&D for improvement of the borrower's products and services and to help them innovate for further expansion while adding more value to Thai exports.

Of the 2.7 million SMEs currently in Thailand, about 25,000 are exporters. With new trade and investment opportunities opening up with the advent of the ASEAN Economic Community by the end of this year, augmented by rapidly burgeoning cross-border trade following an increase in purchasing power of Thailand's neighboring countries, new SME exporters are emerging.

Global mega-trends like aging societies, online commerce, environmental awareness, and healthy lifestyles are also seen as new gateways for SMEs to export their products to meet the demand of different consumer markets.

Furthermore, the new generation of SMEs are beginning to appreciate the

importance of R&D that will lead to innovative product development and help increase their competitive advantage as well as differentiate their products amid the intense competition in the world market.

http://www.nationmultimedia.com

VIET NAM

Technological product export growth

Technological products contributed up to 93.4% in US$4.55 billion of Viet Nam's total export in the first 5 months this year. However, local businesses have attended very little in this performance. The latest report by the General Department of Viet Nam Customs shows that phone and component export turnover totaled nearly US$12 billion, up 20.2% equivalent to US$2 billion over the same period last year. It is the highest-growth commodity of Viet Nam in the first 5 months. Electronic turnover reached US$6.02 billion, up 59.6% or US$2.25 billion. These two commodities brought the export value of US$4.25 billion, accounting for 93.4% of the 5-month export turnover.

Export markets of Vietnamese technological products have broadened. In the 5 months, phone export turnover to European Union, United States, and United Arab Emirates markets went up 13.6%, 64.4% and up 4.8% to US$4.01 billion, US$1.09 billion, and US$1.71 billion, respectively. Experts said that foreign direct investment sector has been the main factor to the turnover growth of technological products.

The world giants like Samsung, LG, Intel, Canon, Microsoft, Nidec, Fujitsu, Brother, Panasonic, Renesas, etc. have expanded production in Viet Nam for the last couple of years. The experts believed that the turnover would continue increasing, but the attention of local suppliers would be very tiny in the coming time.

According to Samsung Group, their plant in Bac Ninh province has hundreds of component suppliers. Of these, only few are Vietnamese who are able to attend in simple phases such as packing and printing. The others come from South Korea, Viet Nam's neighbors and joint ventures of Vietnamese and foreign firms. Similarly, most suppliers of Intel Viet Nam are foreign invested ones. Both Samsung and Intel said that they have faced difficulties in seeking local suppliers.

The condition is unlikely to improve in the time ahead when many technology projects will come into operation such as Samsung consumer electronics complex in the Saigon Hi-Tech Park. LG Group has also decided to move their electronics and household appliance complex from Thailand to Hai Phong city of Viet Nam. Most of Vietnamese suppliers are of small and medium scales and unable to meet these group's demand while Viet Nam has yet to develop the technological industry. It will be difficult for them to attend in global supply chain without Government assistances, added the experts.

http://english.vietnamnet.vn

New technology products showcased

The technology and equipment fair (Techmart) 2015 opened in Ho Chi Minh City on July 9, showing more than 90 new and highly applicable products. Among the products, which are ready to be transferred to enterprises and investors, are technologies to grow herbal medicine components cordyceps robeti and fomes japonicus in synthetic environments, 3D printers applicable in various sectors, automated sewing machines and glass cleaners, and antiseptic fluid.

According to Nguyen Ky Phung, Vice Director of the Ho Chi Minh City Department of Science and Technology, Techmart 2015 aims to support and connect inventors, researchers, and enterprises in technology renovation and transfer. It helps businesses access advanced technology relevant to their production, thus increasing competitiveness in the integration era, he said. Phung added that the fair also targets the formation and development of the technology market, stepping up technology transfer and commercializing highly applicable inventions and research results.

http://english.vietnamnet.vn

Viet Nam advances 19 places on global innovation index

Much to the surprise, and delight, of almost everyone, Viet Nam has not only improved its performance on the global innovation index this year, but outperformed nearly two thirds of other economies. Out of 141 economies around the world, Viet Nam was ranked at 52, up 19 places from last year, according to the latest report co-published by the UN's World Intellectual Property Organization, New York-based Cornell University, and France's business school INSEAD.

The annual index measured an economy's innovative capabilities and measurable results, using 79 indicators related to a variety of sectors such as education, business, infrastructure, and information and communications technology. Scoring 38.85 out of 100, Viet Nam was the second top innovator within the lower-middle income group that consisted of 34 economies, after the Republic of Moldova.

However, its position was still far lower than some of other Southeast Asian countries such as Singapore and Malaysia, which were ranked 7 and 31 and 7, respectively. Switzerland, the UK, Sweden, the Netherlands, and the US were the world's top innovative economies.

Viet Nam's performance has been consistently high in infrastructure, knowledge and technology outputs, and creative outputs, according to the report. It also praised the country for its efforts to develop its national innovation system by improving its regulatory framework and engaging in institution building.

Thanks to its integration in global trade via global value chains and the attraction of foreign direct investment, Viet Nam performed well, when it came to business sophistication which was showed through factors such as knowledge absorption, the report said. However, Viet Nam's performance was still weak in improving its political environment, regulatory environment, and business environment, besides research and development activities, it said. Viet Nam is also facing hurdles in investment environment, and trade and competition, it added.

http://www.thanhniennews.com

AFRICA

TANZANIA

Nanotechnology-based water filtration system

A Tanzanian chemical engineer has won the first Africa Prize for Engineering Innovation with his specialized water-filtration system. Dr. Askwar Hilonga's innovation — a sand-based water filter that cleans contaminated drinking water using nanotechnology — has earned him prize money of UK £25,000 (TZS79 million).

Each nanofilter is engineered for a specific body of water and absorbs the contaminants present — from heavy metals or minerals, such as copper and fluoride, to biological contaminants like bacteria and viruses, and pollutants such as pesticides. After an impressive 33 academic publications, Hilonga's trademarked nanofilter is set for commercialization within a year.

http://www.raeng.org.uk

ASIA-PACIFIC

INDIA

Superior water filter

A membrane capable of producing safe drinking water by filtering out objects at the nanoscale level and killing the commonly found pathogenic bacteria *E. coli* has been developed by a team led by Dr. Suryasarathi Bose, Assistant Professor, Department of Materials Engineering, IISc, Bengaluru. The membrane is produced by mixing two polymers — poly(vinylidene fluoride) (PVDF) and poly(methyl methacrylate) (PMMA) — that become miscible at about 220°C. While PVDF crystallizes during cooling, PMMA does not and separates out; the PMMA is removed using a solvent. This property of selective crystallization and separation is taken advantage of to produce a nanoporous membrane.

As the membrane is about 1 mm thick, a combination of fine pores and channels are produced when the PMMA is removed. The average pore size is 50 nm. "The blend of two polymers is known, but we have been able to use that to produce a nanoporous structure by removing the PMMA," said Professor Bose. The results of the work were published in the *Journal of Materials Chemistry.*

Last year, Dr. Bose had produced a novel membrane that had micron-sized pores (0.57–0.68 microns). It was produced by mixing two polymers polyethylene (PE) and polyethylene oxide (PEO) at 180°C. In this case, the micron-sized pores were produced by removing the water-soluble PEO. Unlike the micro-filtration achieved using the PE polymer, the nanopore structure produced now has greater advantages. "It can support a reverse osmosis membrane," he said. "It can enhance the efficiency of a RO membrane if placed before it."The nanoporous membrane can filter the water and send semi-pure water to the RO membrane. As a result, the RO membrane will require lesser pressure to produce pure water.

The nanosized porous structure can prevent bacteria from passing through the pores as bacteria are typically micron-sized. However, the bacteria can form a biofilm on the structure. As a result, the filter's efficiency will be reduced within a short period. To prevent this and to kill the bacteria, they mixed silver, titanium dioxide, and carbon nanotubes to the PVDF–PMMA mixture. Because of polarity and specific interaction with PVDF, all the three added materials got embedded only on the PVDF.

The three nanoparticles serve two important purposes. First, the nanoparticles promote PVDF crystallization at a much faster rate. As a result of faster crystallization, defective crystals are developed. "We get nanopores of uneven sizes (50–100 nm) and these increase the flow rate of water and hasten the filtration process," Professor Basu said. "Under 25 psi water pressure, the flow rate is more than 2 liters per meter square second."

The second advantage of silver, titanium dioxide, and carbon nanotubes that are embedded on membrane is their ability to kill *E. coli* bacteria. Silver leaches in water when the ions so released kill the bacteria by destroying the integrity of the cell and by damaging the cell proteins and terminating the DNA replication.

http://www.thehindu.com

ISLAMIC REPUBLIC OF IRAN

Nanotechnology for industrial purification of drinking water

The Payamavaran Nanofanavari Fardanegar (PNF) Company for the first time implemented a project to purify drinking water from arsenic by using cavitation and active alumina nanotechnology in Ardabil Province in Iran at industrial scale. The project was implemented in Ardabil Province with the capacity of 40 L/sec (3,450 m^3/day). In this project, heavy metals existing in drinking water are purified with a cost of two or three times lower than the cost of normal purification method.

There are numerous methods in the world for the purification of heavy metals from drinking water at industrial scale, among which mention can be made of reverse osmosis, ion exchanging resins, and suspension method alumina sorbent. Some of the methods, including reverse osmosis are very sensitive to the water quality and costly despite their very good efficiency. Some others such as ion exchanging resins are inappropriate in many areas of Iran because of the presence of ions of other elements such as sulfate.

"The presence of arsenic at concentrations > 10µg/L may have destructive effects on the consumer. This substance increases the risk of various types of cancers because it is adsorbed by the body through the skin. The use of nanocavitation technology oxidizes AS III into AS V. This material is highly adsorbed by alumina sorbents. The life of sorbents increases two or three times because no chemical oxidant is used in the product, and as a result, the operational cost decreases. Chemical oxidants decrease the performance of the sorbents,» Eng. Ali Rakhsha, a member of the Board of Directors of the company stated.

The company has improved the performance of alumina-based sorbents by using this technology. The method has been used at this volume for the first time.

http://www.nanotech-now.com

Purification of wastewater using nanomembranes

Researchers from Amirkabir University of Technology produced a nanomembrane which can purify industrial wastewater and polluted water with over 90% efficiency. The production of the nanomembrane is easy and cost-efficient and reduces the cost of wastewater purification process due to its high efficiency and long lifetime. The removal of heavy metal ions, specially mercury and lead, from industrial wastewater is among the important challenges in environmental issues because of their toxicity and harmful effects on the environment.

Results of the research showed that the synthesized membrane has appropriate permeability and it is able to separate significant amount of heavy metals from the wastewater (>95%). In addition, industrial samples have confirmed the desirable performance of the membrane in the purification of industrial wastewater. Therefore, this achievement can be used in the purification of industrial wastewater and polluted water because of the wide range of the application of membrane processes.

The produced membrane is able to carry out the separation process directly through a single-step process because of its high sorption properties while the normal removal methods, including chemical deposition or the addition of sorbents to the wastewater, usually require a few steps and they include the addition of another substance to the environment.

In this project, the membrane rejection has been increased for heavy metals with conserving its permeability by combining the sorption mechanism by the sorbent and the membrane rejection. In addition, in case the water comes back to the production cycle, the cost of consumed water decreases by controlling the consumption of water.

Results of the research have been published in *Industrial & Engineering Chemistry Research*, vol. 54, issue 1, 2015, pp. 502–513.

http://www.nanotech-now.com

REPUBLIC OF KOREA

Technology to change sea water into fresh water

A Republic of Korean research team has successfully developed a technique to change sea water into fresh water using nanotechnology. The method is expected to contribute to solving water shortages around the world. The research team headed by Professor Lee Jung-hyun at Korea University announced on Jan. 26 that they have succeeded in developing a technique to manipulate the structure and performance of separation films using a nanotechnology. The nanotechnology can make several layers of thin films by stacking molecules on top of one another and assembling those stacked molecules afterwards.

In particular, separation films manufactured by this technique can remove the same amount of salt as existing methods with an 80% better water permeability. So far, it has been difficult to enhance the function and durability of separation films, because the physical and chemical structures of those films are hard to control.

Professor Lee explained, "I think that our research can contribute to increasing local technologies' share of the separation films market for seawater desalination and water treatment in the future." The research findings were first published online on Jan. 5 by ACS Nano, a monthly scientific journal published by the American Chemical Society.

http://www.businesskorea.co.kr

VIET NAM

Water filtration technology

Associate Professor Tran Hong Con from the Hanoi University of Natural Sciences is the creator of the Hanoi dirty-water map, a unique water filtration technology and the inventor of many other water-related research works.

At first, Con used the technology to filter tap water and water from Bay Mau Lake in Hanoi. The filtered water was then brought to the Institute of Hygiene and Epidemiology Center and General Directorate of Measurement and Quality Control for testing. As the tests gave very satisfactory results, Con then tried to filter the water from To Lich River, which is considered the most polluted water in Hanoi and called Hanoi's "black water village".

The water from To Lich, black and smelly, after going through Con's water filtration units, turned clean and pure enough for drinking. The purity of the water filtered by Con has been officially recognized by important agencies in Viet Nam.

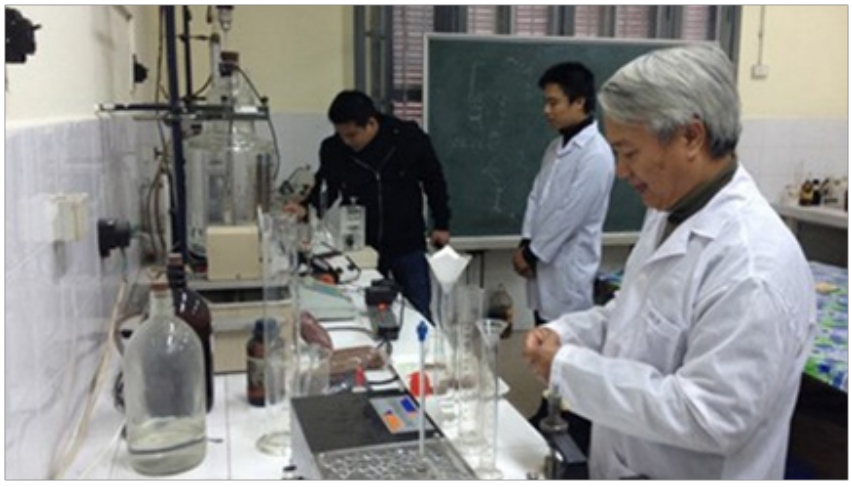
http://english.vietnamnet.vn

EUROPE

GERMANY

Simple method of binding pollutants in water

Researchers at the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB in Stuttgart have opted for a new



approach that combines the advantages of both methods. When manufacturing the membranes they add small, polymeric adsorber particles. The resulting membrane adsorbers can — in addition to their filtration function — adsorptively bind substances dissolved in water. "We make use of the porous structure of the membrane located underneath the separation layer. The pores have a highly specific surface so that as many particles as possible can be imbedded, and they also provide optimum accessibility," says Dr. Thomas Schiestel, Head of the "Inorganic Interfaces and Membranes" working group at the Fraunhofer IGB.

"Unlike conventional adsorbers, our membrane adsorbers transport the pollutants convectively. This means that, with the water flowing rapidly through the membrane pores, a contact time lasting only a few seconds is sufficient to adsorb pollutants on the particle surface," says the scientist. Up to 40% of the weight of the membrane adsorbers is accounted for by the particles, and so their binding capacity is correspondingly high. At the same time, the membrane adsorbers can be operated at low pressures. As the membranes can be packed very tightly, very large volumes of water can be treated even with small devices.

The researchers manufacture the adsorber particles in a one-step, cost-efficient process. In this patented process monomeric components are polymerized with the help of a crosslinking agent to generate 50–500 nm polymer globules. "Depending on which substances are to be removed from the water, we select the most suitable one from a variety of monomers with differing functional groups," Schiestel explains. The spectrum here ranges from pyridine, which tends to be hydrophobic, by way of cationic ammonium compounds and includes anionic phosphonates.

The researchers were able to show in various tests that the membrane adsorbers remove pollutants very selectively by means of the particles, which are customized for the particular contaminant in question. For example, membrane adsorbers with pyridine groups bind the hydrophobic bisphenol A especially well, whereas those with amino groups adsorb the negatively charged salt of the antibiotic penicillin G.

"The various adsorber particles can even be combined in one membrane. In this way we can remove several micropollutants simultaneously with just one membrane adsorber," says Schiestel, pointing out a further advantage. Equipped with different functional groups, the membrane adsorbers can also remove toxic heavy metals such as lead or arsenic from the water. Phosphonate membrane adsorbers, for example, adsorb more than 5 grams of lead per square meter of membrane surface area – 40% more than a commercially available membrane adsorber.

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http://www.igb.fraunhofer.de

THE NETHERLANDS

Nanotechnology for clean drinking water

One way of removing harmful nitrate from drinking water is to catalyze its conversion to nitrogen. This process suffers from the drawback that it often produces ammonia. By using palladium nanoparticles as a catalyst, and by carefully controlling their size, this drawback can be partially eliminated. It was research conducted by Yingnan Zhao of the University of Twente's MESA+ Institute for Nanotechnology that led to this discovery.

Because of the excessive use of fertilizers, our groundwater is contaminated with nitrates, which pose a problem if they enter the mains water supply. Levels have fallen significantly in recent years, as a result of various European directives. In addition, the Integrated Approach to Nitrogen programme was launched in various Dutch nature reserves at the start of Jan. 2015. Tackling the problem at source is one thing, but it will still be necessary to treat the mains water supply. Although this can be achieved through biological conversion (using bacteria to convert the nitrate to nitrogen gas), this is a slow process. Using palladium to catalyze the conversion of nitrate to nitrogen speeds up the process enormously. However, this reaction suffers from the drawback that it produces a harmful by-product – ammonia.

The amount of ammonia produced depends on the method used to prepare the palladium and on the catalyst's physical structure. Yingnan Zhao decided to use nanometer-sized colloidal palladium particles, as their dimensions can be easily controlled. These particles are fixed to a surface, so they do not end up in the mains water supply. However, it is important to stop them clumping together, and therefore stabilizers such as polyvinyl alcohol are added.

Unfortunately, these stabilizers tend to shield the surface of the palladium particles, which reduces their effectiveness as a catalyst. By introducing additional treatments, Yingnan Zhao has managed to fully expose the catalytic surface once again or to manipulate it in a controlled manner. This has resulted in palladium nanoparticles that can catalyze the conversion to nitrogen, while producing very little ammonia. This has brought the further development of catalytic water treatment (in compact devices for home use, for example) one step closer. Yingnan Zhao, who is from Heze, Shandong, China, conducted his research in Prof. Leon Lefferts' Catalytic Processes and Materials group. He defended his thesis, which is entitled "Colloidal Nanoparticles as Catalysts and Catalyst Precursors for Nitrite Hydrogenation" on Thursday, Jan. 15.

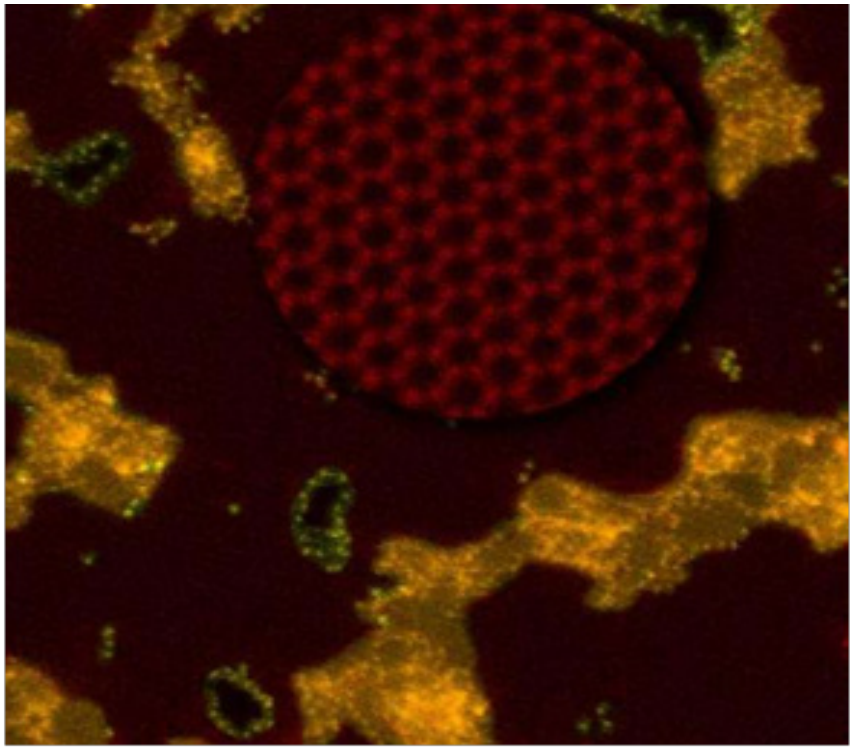
http://www.nanowerk.com

NORTH AMERICA

USA

Desalination with nanoporous graphene membrane

A team of experimentalists led by the Department of Energy's Oak Ridge National Laboratory has demonstrated an energy-efficient desalination technology that uses a porous membrane made of strong, slim graphene — a carbon honeycomb one



Nanopores in graphene (Credit: Oak Ridge National Laboratory, US Dept. of Energy)

atom thick. The results are published in the March 23 advance online issue of *Nature Nanotechnology*. "Our work is a proof of principle that demonstrates how you can desalinate saltwater using free-standing, porous graphene," said Shannon Mark Mahurin of ORNL's Chemical Sciences Division, who co-led the study with Ivan Vlassiouk in ORNL's Energy and Transportation Science Division.

To make graphene for the membrane, the researchers flowed methane through a tube furnace at 1,000°C over a copper foil that catalyzed its decomposition into carbon and hydrogen. The chemical vapor deposited carbon atoms that self-assembled into adjoining hexagons to form a sheet one atom thick. The researchers transferred the graphene membrane to a silicon nitride support with a micrometer-sized hole. Then the team exposed the graphene to an oxygen plasma that knocked carbon atoms out of the graphene›s nanoscale chicken wire lattice to create pores. The longer the graphene membrane was exposed to the plasma, the bigger the pores that formed, and the more made.

The prepared membrane separated two water solutions — salty water on one side, fresh on the other. The silicon nitride chip held the graphene membrane in place while water flowed through it from one chamber to the other. The membrane allowed rapid transport of water through the membrane and rejected nearly 100% of the salt ions, e.g., positively charged sodium atoms and negatively charged chloride atoms. To figure out the best pore size for desalination, the researchers relied on the Center for Nanophase Materials Sciences (CNMS), a DOE Office of Science User Facility at ORNL. There, aberration-corrected scanning transmission electron microscopy imaging, led by Raymond Unocic, allowed for atom-resolution imaging of graphene, which the scientists used to correlate the porosity of the graphene membrane with transport properties. They determined the optimum pore size for effective desalination was 0.5–1 nm, Mahurin said. They also found the optimal density of pores for desalination was one pore for every 100 square nanometers. "The more pores you get, the better, up to a point until you start to degrade any mechanical stability," Mahurin said.

http://phys.org

Patent for next generation water filter

Somenath Mitra, distinguished professor of chemistry and environmental science at the New Jersey Institute of Technology (NJIT), was awarded a patent last month for a next-generation water desalination and purification technology that uses uniquely absorbent carbon nanotubes to remove salt and pollutants from brackish water and industrial effluent for reuse by businesses and households.

Mitra's new carbon nanotube immobilized membrane (CNIM) is an energy-efficient device designed to filter higher concentrations of salt than is currently feasible through reverse osmosis, one of the standard industry processes. It is also used to remove pollutants such as volatile organic compounds (VOCs) — chemicals routinely used in solvents — from water.

Mitra's distillation process runs on energy-efficient fuels such as waste heat, an industrial by-product, and solar energy. Mitra, who has conducted research on carbon nanotubes for the past 15 years, created a novel architecture for the membrane distillation process by immobilizing carbon nanotubes, which are an atom thick and about 10,000 times smaller than a human hair in diameter, in the membrane pores. Ken Gethard, a former doctoral student who helped him develop it, is the co-inventor on the patent. "One of the key characteristics of carbon nanotubes is their capacity to both rapidly absorb water vapor as well as industrial contaminants, including VOCs, and then easily release them," he notes.

In the case of fracking, the fresh water and chemicals that are pumped into the ground to release natural gas trapped beneath rocks absorb high concentrations of salt from the soil they pass through before returning as polluted water in need of treatment. Reverse osmosis, which relies on power-driven pump pressure to force water through a membrane, is not commonly used to treat this so-called

produced water because it typically contains very high concentrations of salt, requiring extremely high pressure.

The electric power industry, which uses a vast amount of water to cool its generators, is also eager to come up with more efficient processes to treat its wastewater, including the incorporation of waste heat.

http://www.njit.edu

Nanotechnology mesh lets water through

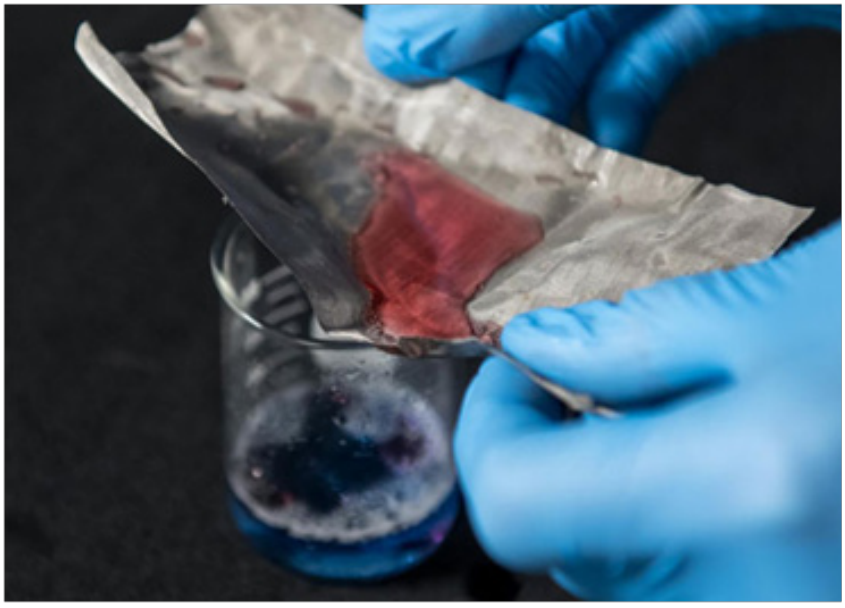
The unassuming piece of stainless steel mesh in a lab at The Ohio State University does not look like a very big deal, but it could make a big difference for future environmental cleanups. Water passes through the mesh but oil does not, thanks to a nearly invisible oil-repelling coating on its surface. In tests, researchers mixed water with oil and poured the mixture onto the mesh. The water filtered through the mesh to land in a beaker below. The oil collected on top of the mesh, and rolled off easily into a separate beaker when the mesh was tilted.

The mesh coating is among a suite of nature-inspired nanotechnologies under development at Ohio State and described in two papers in the journal *Nature Scientific Reports* ("Mechanically durable, superoleophobic coatings prepared by layer-by-layer technique for anti-smudge and oil–water separation" and "Nanomechanical behavior of MoS2 and WS2 multi-walled nanotubes and Carbon nanohorns"). Potential applications range from cleaning oil spills to tracking oil deposits underground."If you scale this up, you could potentially catch an oil spill with a net," said Bharat Bhushan, Ohio Eminent Scholar and Howard D. Winbigler Professor of mechanical engineering at Ohio State.

The work was partly inspired by lotus leaves, whose bumpy surfaces naturally repel water but not oil. To create a coating that did the opposite, Bhushan and postdoctoral researcher Philip Brown chose to cover a bumpy surface with a polymer embedded with molecules of surfactant — the stuff that gives cleaning power to soap and detergent. They sprayed a fine dusting of silica nanoparticles onto the stainless steel mesh to create a randomly bumpy surface and layered the polymer and surfactant on top. The silica, surfactant, polymer, and stainless steel are all non-toxic and relatively inexpensive, said Brown. He estimated that a larger mesh net could be created for less than a dollar per square foot. Because the coating is only a few hundred nanometers (billionths of a meter) thick, it is mostly undetectable. To the touch, the coated mesh does not feel any bumpier than uncoated mesh. The coated mesh is a little less shiny, though, because the coating is only 70% transparent.

The researchers chose silica in part because it is an ingredient in glass, and they wanted to explore this technology's potential for creating smudge-free glass coatings. At 70% transparency, the coating could work for certain automotive glass applications, such as mirrors, but not most windows or smartphone surfaces.

http://www.nanowerk.com



The nanotechnology captures oil (red) while water (blue) passes through. (Credit: Jo McCulty, The Ohio State University)

Nanotechnology-based method to purify drinking water

Theresa Dankovich, a researcher from University of Virginia's Center for Global Health, the United States, has discovered and developed an inexpensive, simple and easily transportable nanotechnology-based method to purify drinking water. She calls it *The Drinkable Book*, and each page is impregnated with bacteria-killing metal nanoparticles.While earning her doctorate at McGill University, she found that sheets of thick filter paper embedded with silver nanoparticles could do just that, eliminating a wide variety of microorganisms, including bacteria and some viruses.

Although silver and similar metals have been known for centuries to have the ability to kill bacteria, no one had put them into paper to purify drinking water, Dankovich notes.Dankovich also began field investigations of water purification applications in Limpopo, South Africa, as well as northern Ghana, Haiti and Kenya. "In Africa, we wanted to see if the filters would work on 'real water,' not water purposely contaminated in the lab," she says. "One day, while we were filtering lightly contaminated water from an irrigation canal, nearby workers directed us to a ditch next to an elementary school, where raw sewage had been dumped.

Source: http://phy.org

SMART SPECIALISATION FOR REGIONAL ECONOMIC TRANSFORMATION

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Abstract

The aim of this article is to provide a quick yet comprehensive understanding of the nature and logic of smart specialisation as a place-based strategy for economic transformation and development. The origin and characteristics of the smart specialisation approach in the European Union are presented together with the main challenges for a successful implementation. Smart specialisation is about identifying and pursuing sub-sectoral and inter-sectoral activities, which can be explored by not only existing but also new entrant firms, where technology can facilitate either radical innovation or the incremental utilisation of existing skills/strengths in new niches, fostering regional and national technology-savvy economic transformation. Stakeholder involvement through an entrepreneurial discovery process is a defining feature of this approach.

Introduction

The European Commission has been promoting in the last few years a new approach to innovation and research policy which is now applied in several regions and countries of the European Union (EU) and has also gained a considerable momentum outside Europe. This approach is known as *smart specialisation* and aims to valorise the socio-economic assets of a territory and develop them in a context of global challenges and rapid diffusion of knowledge. This approach has been operationalised through the definition of regional and/or national strategic policy frameworks for selective R&D and innovation policy making that are referred to as *innovation strategies for smart specialisation* (RIS3). As of June 2015, European regions and countries have finalized or are in the process of completing their RIS3, and for the first time, an innovation and research policy is applied at such a vast scale according to a common process and set of principles.

Smart specialisation centres on a process of identification and selection of desirable areas for public intervention, implying choices of technologies, economic activities, knowledge domains, sub-systems within the sectoral fabric of business relationships that could and should be especially supported by targeted public investment. These activities should be able to produce scale and agglomeration economies or be subject to coordination failures that constitute the main rationale for public intervention (Foray and Goenaga, 2013).

The concept of smart specialisation was initially developed as a research-side top-down concept, emphasising a bird's eye-view of Europe as one entity, uniquely focused on RTD location. Thanks to work by analysts — including crucially and early on analysts of the Joint Research Centre, Institute for Prospective Technological Studies (JRC-IPTS) — the drawbacks of this early view were identified (failure to see high concentration already in place, failure to see the risks of monopsony/monopoly emerging, absence of redistributive mechanisms, etc.). Starting already at the meetings of the *knowledge-for-growth* expert group of EU Commissioner Potočnik, where the JRC-IPTS participated, and where the concept fully emerged, a recasting of this early view began, towards turning it from a top-down research-side concept to a bottom-up, place-based, technology-wielding approach to regional economic transformation. The adoption of smart specialisation as a guiding principle for this iteration of the European Structural and Investment Funds (2014–2020) brought particular pride and satisfaction for the JRC.

Smart specialisation lies at the core of the revised European Cohesion Policy, as a fundamental driver of a successful *Europe 2020* strategy (European Commission, 2010). The overarching regulation for the new 2014–2020 Cohesion Policy explicitly provides that the disbursement of funds related to R&D, innovation, ICT development, and support to SMEs is conditional on the existence of national or regional RIS3. Finally, the European Commission created the *S3 Platform* to support regional policy makers in the process of applying the logic of smart specialisation to their specific contexts.

The aim of this article is to provide a quick yet comprehensive understanding of the nature and logic of RIS3, as well as of their characterizing principles and elements.

Disclaimer: The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

Box 1: RIS3 design principles

(i) Smart specialisation is a place-based approach, which builds on the assets and resources available to regions and countries and on their specific socio-economic challenges to identify unique opportunities for development and growth.

(ii) To have a strategy means to make choices for investment. Regions and countries ought to support only a limited number of well-identified priorities for knowledge-based investments and/or clusters. Specialisation means focusing on competitive strengths and realistic growth potentials supported by a critical mass of activity and entrepreneurial resources.

(iii) Setting priorities should not be a top-down, picking-the-winner process. It should be an inclusive process of stakeholders' involvement centred on entrepreneurial discovery that is an interactive process in which market forces and the private sector are discovering and producing information about new activities and the government assesses the outcomes and empowers those actors most capable of realizing this potential.

(iv) The strategy should embrace a broad view of innovation, supporting technological as well as practice-based and social innovation. This would allow each region and country to shape policy choices according to their unique socio-economic conditions.

(v) Finally, a good strategy must include a sound monitoring and evaluation system as well as a revision mechanism for updating the strategic choices.

What is an innovation strategy for smart specialisation?

A strategy for smart specialisation, or RIS3, is an economic transformation agenda operating through coordination of financial and entrepreneurial resources in a selected set of areas with the highest transformative potential for the economy. The strategy should be designed around the five key principles reported in Box 1.

These elements should be clearly reflected in the RIS3 documents and exhaustively explained. The Guide to Research and Innovation Strategies for Smart Specialisations (European Commission, 2012) provides a simple six-step approach to RIS3, where the mentioned leading elements are re-composed around a logical design structure: (1) analysis of the regional and national context and potential for innovation; (2) set up of a sound and inclusive governance structure; (3) production of a shared vision about the future of the economy and the society; (4) selection of a limited number of priorities for development; (5) establishment of suitable policy mixes; and (6) integration of monitoring and evaluation mechanisms. These steps should be thought of as interacting components of a comprehensive design scheme whose implementation pattern depends on the specificity of the regional and national context.

Identification and selection of investment priorities

The central insight of smart specialisation is that, beyond horizontal measures aimed to improve framework conditions and general capabilities of the economic system, it is crucial to identify a closed set of *priorities* for development where to concentrate resources. Such priorities should be economic activities where regions or countries have a competitive advantage or have a high potential to generate knowledge-driven growth and to bring about the economic transformation needed to tackle the major and most urgent challenges for the society and the natural and built environment.

Such priorities could be framed in terms of knowledge fields or activities (not only science-based, but also social, cultural and creative ones), sub-systems within a sector or cutting across sectors and corresponding to specific market niches, clusters, technologies, or ranges of application of technologies to specific societal and environmental challenges or health and security of citizens (e.g., ICT for active ageing, mobility solutions to reduce traffic congestion, innovative material solutions for eco-construction, etc.). Although some regions or countries may prioritize one or more Key Enabling Technologies, others will focus on applications of such technologies to specific purposes or defined fields (Sörvik and Kleibrink, 2015).

Social, organisational, market and service innovation, or practice-based innovation, play as important a role in RIS3 as technological innovation based on scientific research. This is especially relevant for less-developed regions with comparatively weaker technological and science basis. RIS3 involves not only radical innovation but also exploiting niches by innovating in traditional fields, through developing and applying new business or organizational models, and adapting/exploiting innovations deriving from tacit knowledge and experience in these areas.

Priorities should be identified based on the combination of two fundamental processes: (1) *Objective analysis* of the region or country current situation in terms of research, innovation, industrial structures, skills and human capital, demand, public and private budgets for research and innovation, framework conditions, functioning of the innovation eco-systems; this should also include an examination of comparative advantages and complementarities with other international competitors. (2) *Entrepreneurial discovery process* by which policy makers involve all types of innovation actors (e.g., businesses, technology and competence centres, universities and public agencies, science and business parks, business angels and venture capitalists, civil society) for the design and implementation of RIS3.

Above all, priority setting cannot be regarded as a straightforward process whose outcome can be decided once and for all. Priority setting requires a certain degree of experimentation with new policy tools, ideally through pilot projects during the process of elaboration and modification of the RIS3. This in turn requires a strong governance system with sufficient political backing, to take risks and allow for failures from which lessons can be learned.

A key feature of RIS3 is its reliance on *collaborative leadership*. This means that

no single institution alone is able to write such a strategy: RIS3 is about partnership and should be developed with the active involvement of many different types of actors. The involvement of entrepreneurs, broadly defined, is especially important to the "entrepreneurial process of discovery", because they are best placed to know what is likely to work in a particular place and with whom abroad cooperation can be helpful. This type of institutional capacity building cannot happen overnight and should be reinforced as the strategy is developed and implemented. Likewise, the entrepreneurial discovery process can also be described as a "journey" with no start or end.

The entrepreneurial discovery process

The entrepreneurial process of discovery plays a central role in and is one of the main defining features of the smart specialisation approach. It is a key process utilizing entrepreneurial knowledge existing in a region or country and taking an entrepreneurial approach in the sense of focusing on market opportunities, differentiating from others, taking (and managing) risks and seeking alliances to optimise the access to and use of resources (physical, financial, intellectual, market knowledge, etc.). Simple surveys among the actors participating in this process are, by the way, not sufficient. The essence of the entrepreneurial discovery lies in its interactive nature that brings the different actors together in a participatory leadership process to carve out jointly the smart specialisation activities and niches.

This means that the regional government no longer plays a role of omniscient planner but it will assess the potential of the new activities and empower those actors which are most capable of realizing that potential. This helps avoiding the shortcomings of purely political interest-driven or consultant-written strategies, because full stakeholder involvement through entrepreneurial discovery process allows to draw operational conclusions out of the results of the SWOT/statistical type of analysis to shape ownership around the strategies and to design the intervention methods according to the needs of innovation actors, in particular of course the enterprises.

The entrepreneurial discovery process marks a clear discontinuity with previous policy-making practices. Since the novelty of smart specialisation, decisions on research and innovation strategies have been often designed by public authorities by means of a top-down approach in which they would lead and define this process, with no or little consultation and involvement of regional stakeholders. Smart specialisation changes this culture and promote moving to a bottom-up process whereby public bodies acts more as facilitators than sole leaders of this process (Martínez and Palazuelos-Martínez, 2014).

RIS3 as a result-oriented process

The whole smart specialisation approach in the context of European policy is intended to be result-oriented. This can only be achieved by means of a sound strategic architecture that is consequent with the propositions constituting the very essence of the RIS3. In this respect, it is worth recalling that any strategic approach can be decomposed into three main functional building blocks: detection of needs and challenges, i.e., identification of problems; decision on the desired transformations, i.e., selection of the most urgent needs and their reframing in terms of strategic objectives; and definition of the responses to put in place to meet the objectives, i.e., formulation of solutions to selected problems.

In the case of a place-based economic transformation strategy as the RIS3, the needs and challenges are expressed by the society and the community of citizens and social and economic actors. The strategic objectives are the "big" desired and expected changes for the entire socio-economic system of a region or country ultimately endorsed by the bodies entitled to political representation. The responses aimed to meet strategic objectives can be seen as operational solutions consisting of specific combinations of four elements: levers to change the existing state of affairs in specific socio-economic dimensions; economic or knowledge domains or specific markets where to apply such levers; actors that can activate the levers; economic or regulatory instruments of intervention to trigger and support the actors in this action (Gianelle and Kleibrink, 2015).

Identifying strategic solutions translates to naming the chosen levers, domains/markets, groups of relevant actors and instruments. In particular, the characterisation of RIS3 priorities allows determining the nature and scope of the desired and realistically achievable change we aspire to in a given socio-economic dimension within a given socio-economic system. In a strategic context, this is what we call the *expected change*. The mix of policy instruments targeted at a definite group of actors will then be chosen to contribute to the defined expected change.

RIS3 monitoring mechanisms

In order to guarantee that policy interventions are effective in achieving the RIS3 objectives, the strategic design will integrate a monitoring system that should be crafted according to three main purposes: (i) learning about actual transformation processes and informing policy (re)actions accordingly; (ii) building and reinforcing trust and cooperation with and among stakeholders and citizens; and (iii) guarantee accountability of policy making. The monitoring system serves these purposes by performing three key functions: *gathering information* and making it available to decision makers; *clarifying the purpose and functioning of the strategy* and making it comprehensible to the broader public; and *supporting constructive involvement and participation* of stakeholders through transparent communication (Gianelle and Kleibrink, 2015).

The explicit identification of the expected changes is equivalent to setting specific objectives for the RIS3 and hence it is a fundamental element of a strategic outline and essential to construct a monitoring system. An expected change can be specified in several ways, but in general it is necessarily and sufficiently defined by three aspects: (i) a variable of socio-economic nature that can effectively capture the direction and relative and absolute magnitude of the change in qualitative

or quantitative terms and that can be observed and measured; (ii) baseline and target values for the variable; and (iii) a timeframe for observing the actual evolution of the variable.

The variable capturing the expected change is the *result indicator* associated to it. Once the result indicator is selected, it is essential to identify baseline and target values. Only in this way we can indeed appreciate whether a change is actually materialising (baseline vs. actual value) and whether the actual change is going in the desired direction at the desired pace (actual value vs. target value).

The choice of the policy instruments that are assumed to make the expected change happen will allow identifying the output of the policy action that is the "product" the instrument delivers. Such a product and its generative process can be captured by one or more *output indicator* defined as an exactly measurable variable that quantifies the extent to which the actions provided for by the instrument actually reach the target population.

In the context of RIS3, the activity of monitoring has the primary and to some extent new goal of following the evolution of output and result variables over time with respect to target values.

The outward looking dimension of strategy making

International collaboration for research and innovation is becoming increasingly relevant, as evidenced by growing shares of international R&D projects, co-patenting and co-publications. This global dispersion of knowledge is likely to continue as research further internationalises and companies continue to expand their value chains and resort to open innovation strategies to source knowledge globally.

The importance of global innovation networks calls for a type of place-based innovation policy that goes beyond regional or national borders and takes into account the degree to which actors in a given territory are able to connect to, and benefit from such networks and resources. An "outward looking" approach to innovation policy, including collaboration in the design and implementation of policy instruments, may help regions and countries, particularly lagging ones, to overcome fragmentation and lack of critical mass and facilitate access to research capacity, production expertise and finance that can be locally scarce.

Inter-regional, international collaboration is a key component of the implementation of RIS3. The RIS3 guide (European Commission, 2012) indeed emphasises the need for innovation strategies to adopt an "outward looking" approach in terms of their orientation towards global value chains, the assessment of priorities *vis-à-vis* other regions and countries, as well as the consideration of cross regional and national projects and networks.

Inter-regional, international collaboration for research and innovation can pursue multiple goals, take multiple forms, involve a variety of actors, and utilise a range of instruments that range from short-term projects to long-term strategic partnerships. Each option has different risks and preconditions, including different forms of proximity, differences in national regulations and institutional systems, trust and political commitment, and regional actors need to consider the trade-offs of each option to their needs (Uyarra *et al.*, 2014).

Transnational learning as a way to enable change

Smart specialisation strategies are meant to change the socio-economic *status quo* through inclusive, transformative processes. Very often regions, countries and their development institutions or partnerships have a hegemonic self-understanding or "story" of what they are doing. These stories often tend to take their existing strategies and practices as given. Change is only possible through reflection on these practices from an analytical point of view which is located outside this self-understanding. We have to put the practices and the stories explaining the practices on the table and discuss and analyse them. In order to be able to reflect on what we are already doing, we have to look on ourselves from the perspective of an outsider.

The smart specialisation approach, operationalised through RIS3, provides a common framework, a common language, and opportunities for *transnational learning*. It is the first step in the direction of a new perspective on local systems of innovation. This new perspective might help to discover problems and shortcomings which are invisible seen from an insider perspective, or opportunities and new strategies you might need in the future. In other words, the new perspective could lead to real change.

Using transnational learning to change the local economy takes a coordinated effort, which involves several phases of analysis and planning. It is an analytical task to find out what lessons needs to be learnt, and it is a task of RIS3 policymaking to identify how they can be implemented, and to do it. A point of departure is to look for other regions and countries which may provide relevant input and guidance. Preferably, this should be places which in important and relevant ways are comparable to our own ones, in terms of spatial structure, institutional setup, sectoral specialisation or along other dimensions where we might need assistance (Mariussen *et al.*, 2014).

Institutional capacity

Smart specialisation is a challenging approach to implement because it requires high levels of cooperation between different types of institutions at various geographic levels. On the one hand, it crosses ministerial responsibilities, combining research and innovation policies with economic development and regional cohesion. For example, in most EU Member States, the European Structural and Investment Funds are managed by separate government departments at national or regional level than those that are competent for research and innovation. Smart specialisation promotes holistic strategies that consider innovation in a broad sense, and other policy areas may also have very important roles to play, such as those for society and employment, education, agriculture, competition or spatial planning. Yet the nature of many public administrations is to work in silos, with low levels of cooperation between policy areas.

On the other hand, smart specialisation promotes a place-based approach

to economic development which is sensitive to differences in "regional innovation systems". These differences are related to human and physical capital, the nature of the economy, the natural environment or geographic location. However, they are also very much influenced by formal and informal institutions, what has been described as "orgware" (Vazquez-Barquero, 2006). This institutional capacity includes the roles played by regional governments (Rodríguez-Pose *et al.,* 2014) as well as innovation actors such as development agencies, business associations or universities (Kempton *et al.*, 2013). It also describes "soft institutions", such as local norms and conventions and levels of trust and cooperation. Together these institutions can be described as the "innovation eco-systems" in which smart specialisation strategies operate.

Yet regions are not atomised entities that operate independently. In addition to the regulatory and macro-economic climate that is mostly set at national level, regions are increasingly affected by European and international institutions. Smart specialisation has become important because of the EU's new Cohesion Policy which sets broad guidelines as to how European funds can be spent, which is then translated into co-managed Operational Programmes; a system which has been described as "multi-level governance" (Hooghe and Marks, 2003). More generally, smart specialisation comes at a time of increased integration of the global economy with high levels of interdependence. Regions can be influenced by decisions taken far away and therefore development strategies need to be flexible and resilient.

Two features of the smart specialisation approach illustrate the importance of high levels of institutional capacity, and how this can vary between regions. Firstly, the entrepreneurial process of discovery calls for a collective process of reflection on the innovative capabilities of the regional economy, requiring a common vision and understanding. This process may happen naturally in some places such as Baden-Württemberg (Germany) or Flanders (Belgium) because of a high level of interaction between innovation actors, especially firms. However, in other areas with low levels of private R&I or limited tradition of cooperation between competitors, there is a crucial role for other institutions, including the state. The entrepreneurial process of discovery is concerned with the collection of information to know which activities have the most potential in a particular economy. Firms often hold this information, but it may also be uncoordinated which requires the intervention of other types of institutions.

Following a discovery process, smart specialisation calls for the selection of a limited number of priority areas for investment. In the EU context, this includes the use of structural funds, which in some European regions is a high proportion of overall state spending. The challenge here is for public institutions (for EU funds the "Managing Authorities") to set priorities that are based on analysis of the region and the views of stakeholders, without being influenced by powerful lobbies. The danger of capture by vested interests can be avoided with a transparent and well-designed governance structure for designing and implementing a strategy. This may include a steering group of different regional organisations with external expertise that governs a dedicated management team. An independent monitoring and evaluation system will help to ensure that the process is working in the overall regional interest, and that the R&I priorities that were selected are being strengthened.

The integration of different perspectives and interests, including government departments, private firms, researchers or civil society at large is therefore at the heart of smart specialisation. This process can be described as building institutional capacity. It is a crucial pre-requisite for the successful implementation of smart specialisation strategies. However, recognising the importance of institutions is one thing, and another is changing their behaviour (Rodríguez-Pose, 2013). As with the place based dimension to selecting priorities, strategies must take into account the specific nature of regional institutions and not attempt to replicate governance systems in different institutional contexts.

Challenges ahead

A useful concise formulation regarding the above can be the following: smart specialisation is about identifying and pursuing sub-sectoral and inter-sectoral activities, which can be explored by not only existing but also new entrant firms, where technology can facilitate either radical innovation, or the incremental utilisation of existing skills/strengths in new niches, fostering regional and national technology-savvy economic transformation.

The reception of smart specialisation has been quick and positive in Europe and internationally, nevertheless its implementation poses a few challenges that require the attention of policy makers and the work of scholars and analysts. According to the view and analyses of the JRC-IPTS, there are four main challenges ahead:

(1) There is still need to work on a common understanding of the notion of entrepreneurial discovery and, most important, on how to effectively operationalise it in the context of national and regional development policy and in a way that allows for lessons to be learnt and good practices to be transferred across borders.

(2) During RIS3 implementation, the activities, results, and policy output should be monitored with continuity and ways must be devised to feed back the resulting evidence in the strategy revision process in order for RIS3 to continuously adjust and adapt to changing conditions in the socio-economic context.

(3) The design of development strategies based on smart specialisation principles should not be carried out by closed clubs of incumbent stakeholders, existing firms and administrative authorities. Entry of new, emerging actors should not be precluded, as major innovation potential may lie precisely in those firms that are not yet born or that are just moving their first steps in this world. In other words, strategic design should "give voice to the voiceless" and not be captured by vested interests.

(4) Vigilance should be kept high to guarantee that the bottom-up component of strategy development is preserved and that the whole process does not turn into a mere top-down exercise, driven by research priorities/views (the early "green" conception of smart specialisation), as opposed to the bottom-up, place-based, regional economic transformation approach driving smart specialisation strategies. This, moreover, is especially important as far as the entrepreneurial discovery process is concerned.

References

- ✓ European Commission (2010). "Europe 2020. A strategy for smart, sustainable and inclusive growth", Communication COM (2010) 2020, European Commission.
- ✓ European Commission (2012). *Guide to Research and Innovation Strategies for Smart Specialisation (RIS3)* (Bruxelles, Belgium, European Commission Publication Office).
- ✓ Foray, D. and X. Goenaga (2013). "The goals of smart specialisation", S3 Policy Brief Series No. 01/2013, JRC-IPTS.
- ✓ Foray, D. and B. Van Ark (2007). "Smart specialisation in a truly integrated research area is the key to attracting more R&D to Europe", *Knowledge for Growth Expert Group Policy Brief No. 1*, European Commission.
- ✓ Gianelle, C. and A. Kleibrink (2015). "Monitoring Mechanisms for Smart Specialisation Strategies", S3 Policy Brief Series No. 13/2015, JRC-IPTS.
- ✓ Hooghe, L. and G. Marks (2003). "Unraveling the Central State, but How: Types of Multi-Level Governance", *American Political Science Review*, Vol. 97, No. 2, pp. 233–243.
- ✓ Kempton. L, J. Goddard, J. Edwards, F. Barbara Hegyi and S. Elena Pérez (2013), "Universities and Smart Specialisation", S3 Policy Brief Series, No. 03/2013, JRC-IPTS.
- ✓ Mariussen, Å., I. Midtkandal and R. Rakhmatullin (2014). "A Policymakers Guide to Transnational Learning in Smart Specialisation", S3 Policy Brief Series No. 05/2014, JRC-IPTS.
- ✓ Martínez, D. and M. Palazuelos-Martínez (2014). "Breaking with the Past in Smart Specialisation: A New Model of Selection of Business Stakeholders within the Entrepreneurial Process of Discovery", S3 Working Paper Series No. 04/2014, JRC-IPTS.
- ✓ Rodríguez-Pose, A. (2013). "Do Institutions Matter for Regional Development?", *Regional Studies*, Vol. 47, No. 7, pp. 1034-1047.
- ✓ Rodríguez-Pose, A., M. di Cataldo and A. Rainoldi (2014). "The Role of Government Institutions for Smart Specialisation and Regional Development", S3 Policy Brief Series, No. 04/2014, JRC-IPTS.
- ✓ Sörvik, J. and A. Kleibrink (2015). "Mapping Innovation Priorities and Specialisation Patterns in Europe", S3 Working Paper Series No. 08/2015, JRC-IPTS.
- ✓ Uyarra, E., J. Sörvik and I. Midtkandal (2014). "Inter-regional Collaboration in Research and Innovation Strategies for Smart Specialisation (RIS3)", S3 Working Paper Series No. 06/2014, JRC-IPTS.
- ✓ Vazquez-Barquero, A. (2006). *Endogenous Development* (Abingdon, UK, Routledge). ■

QUADRUPLE INNOVATION HELIX AND SMART SPECIALIZATION KNOWLEDGE PRODUCTION AND NATIONAL COMPETITIVENESS

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Abstract

Investing more in research, innovation, and entrepreneurship is at the heart of Europe 2020 and the only way to achieve growth that will be smart, sustainable, and inclusive. Smart specialization emerges as a key element for place-based innovation policies. Through this article we present the six major steps that every nation/region should follow to establish a smart specialization strategy based on the basic principles as described in the European Union Research and Innovation Strategies for Smart Specialization (RIS3), accompanied by some examples of excellence from the Nordic countries. We explain the linkage between innovation and knowledge and between innovation productivity and competitiveness. Finally, we discuss the need to apply the Quadruple Helix approach in the context of RIS3.

Introduction

"Smart Specialization Strategy means the national or regional innovation strategies which set priorities in order to build competitive advantage by developing and matching research and innovation own strengths to business needs in order to address emerging opportunities and market developments in a coherent manner, while avoiding duplication and fragmentation of effort. A smart specialization strategy may take the form of, or be included in a national or regional research and innovation strategic policy framework"

(Regulation 1301/2013 – European Commission, 2014)

The European Union (EU) has set out its vision for Europe's social market economy in the Europe 2020 strategy that aims at confronting structural weaknesses through progress in three mutually reinforcing priorities (European Commission, 2012):

- Smart growth, based on knowledge and innovation;
- Sustainable growth, promoting a more resource efficient, greener, and competitive economy; and
- Inclusive growth, fostering a high employment economy delivering economic, social, and territorial cohesion.

Investing more in research, innovation, and entrepreneurship is at the heart of Europe 2020 and a crucial part of Europe's response to the economic crisis.

Europe contains many different countries and regions, each with its own system for development and innovation, and with a distinct economic background. Smart specialization strategy needs to differ in different regions and cannot be formulated on a national level alone. There might be significant differences between regions dedicated for international export or agriculture, for instance. Different regions have different challenges and also unique abilities (Midtkandal and Sörvik, 2012). Thus, being smart is not copying other regions' great ideas, particularly if the regions differ significantly from the home region. Essentially the idea is to develop a strategy for one's own region based on its strengths. Smart specialization strategies can be based on existing strategies, as long as those are made for the region in question and can be empirically proved to be accurate (Foray *et al*., 2012).

The main aim of this article is to explore the linkages between innovation, productivity, and competitiveness (IPC). Carayannis and Sagi (2001) emphasize that innovation and competitiveness are intrinsically unified; although one does not cause the other, both are necessary for competitiveness and for each other. We also explain the connection between knowledge creation, diffusion, and innovation flow. According to Carayannis (2001), "Mode 3" knowledge system and Quadruple Innovation Helix models could serve as the foundation for diverse smart specialization strategies as they place a stronger focus on cooperation in innovation, and in particular, the dynamically intertwined processes of co-opetition, co-evolution, and co-specialization. Smart specialization approach is helping regions to upgrade their research and innovation strategies based on a number of key principles including the implementation of multi-level governance. By applying a Quadruple Helix approach, regional policymakers are

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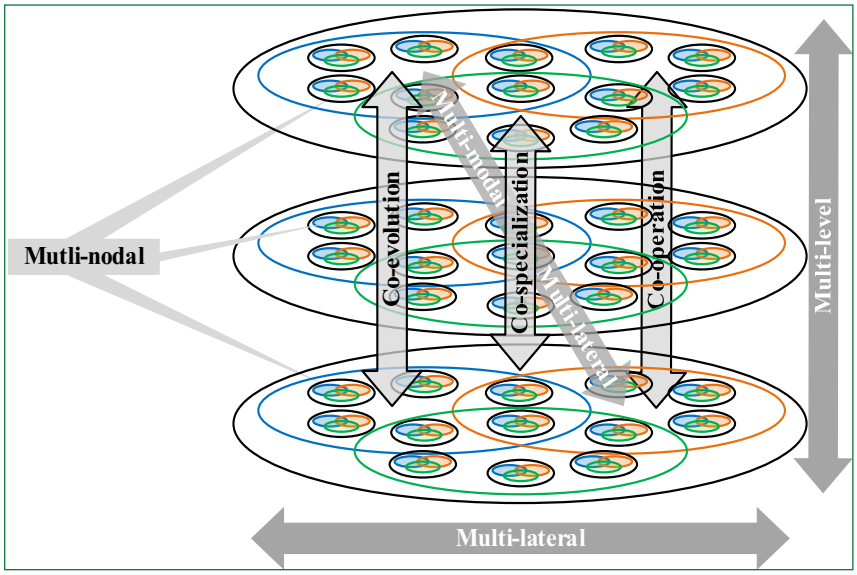


Source: Carayiannis et al. (2008)

Figure 1: Strategic knowledge, serendipity, and arbitrage: multi-modal, multi-nodal, multi-lateral, multi-level 3C's processes

more likely to enable a place-based entrepreneurial process of discovery, which would then generate intensive experimentation and discoveries enhancing at the same time innovativeness.

Mode 3 knowledge production system

The emerging *gloCalising* (globalizing-localizing) frontier of converging systems, networks, and sectors of innovation that is driven by increasingly complex, non-linear, and dynamic processes of knowledge creation, diffusion, and use, confronts us with the need to re-conceptualize, if not to re-invent, the ways and means that knowledge production, utilization, and renewal takes place in the context of the knowledge economy and society.

Perspectives from and about different parts of the world and diverse human, socio-economic, technological and cultural contexts are interwoven to produce an emerging new worldview on how specialized knowledge, which is embedded in a particular socio-technical context, can serve as the unit of reference for stocks and flows of a hybrid, public/private, tacit/codified, tangible/virtual good, which represents the building block of knowledge economy, society, and policy.

Carayannis (2001) argues that "Mode 3" model is the knowledge production system architecture that engages actively higher order learning (learning, learning to learn, learning to learn how to learn), in a multi-lateral, multi-nodal, multi-modal, and multi-layered manner involving thus entities from government, academia, industry, and civil society, as well as driving co-opetition (competition-cooperation), co-specialization, and co-evolution resource generation, allocation, and appropriation processes (*3C's*) that result in the formation of modalities such as innovation networks and knowledge clusters (Figure 1).

Organizations are open systems operating under conditions of substantial turbulence, risk, and uncertainty and seeking to balance stability and coherence with flexibility and change in pursuit of higher levels of efficacy and organizational sustainability (Carayannis *et al.*, 2014)

Firms use the "new knowledge derived through the healthy balance between competition and cooperation involving employees and business partners" in the definition of their real options. These real options serve as the basis for their decision making so as to reap the full benefits of the flexibility embedded in their investments. By the exercise of their options, firms have changed the parameters of their previously temporarily stable ecosystem, resulting in a now unstable environment. Having completed the co-opetition process, firms create "new knowledge through a series of interactions and changes at various levels of the organization, spurred by the co-generation and complementary nature of that knowledge", what Carayannis and Campbell (2009) called strategic knowledge co-evolution. Through innovation, they also undergo strategic knowledge co-specialization, "learning and knowledge which encourages individuals or groups to expand their roles into new areas and new domains, in a complementary and mutually-reinforcing fashion."

Innovation emerges from three critical firm level factors, i.e., posture, propensity and performance, where (Figure 2):

- Input indicators mainly measure resources that are put into the innovation process. These inputs include intellectual, human, and technological capital.
- Process indicators reflect the organizational and innovation management systems. They also embody the design of a firm's innovation system and its innovative.
- Performance indicators (output, outcome, impact), identify the results of organizational innovation. Output indicators represent the realized short-term success of innovative activity. Indicators of this group count patent numbers, rate, number of new products percentage of sales with innovations and other. Outcome indicators represent the realized longer term success of innovative activity such as market share, firm profit margins, and firm growth rate. The impact measure indicates the sustained advantage a firm enjoys as a result of innovation.

Strategic Knowledge Arbitrage and Serendipity (SKARSE) are real option drivers triggered from the 3C's. Strategic knowledge serendipity refers to the unintended benefits of enabling knowledge to "spill over" between employees, groups, and functional domains ("happy accidents" in learning). More specifically,

it describes the capacity to identify, recognize, access, and integrate knowledge assets more effectively and efficiently to derive, develop, and capture non-appropriable, defensible, sustainable, and scalable pecuniary benefits, whereas strategic knowledge arbitrage refers to the ability to distribute and use specific knowledge for applications other than the intended topic area. It refers to the capacity to create, identify, reallocate, and recombine knowledge assets more effectively and efficiently to derive, develop, and capture non-appropriable, defensible, sustainable, and scalable pecuniary benefits.

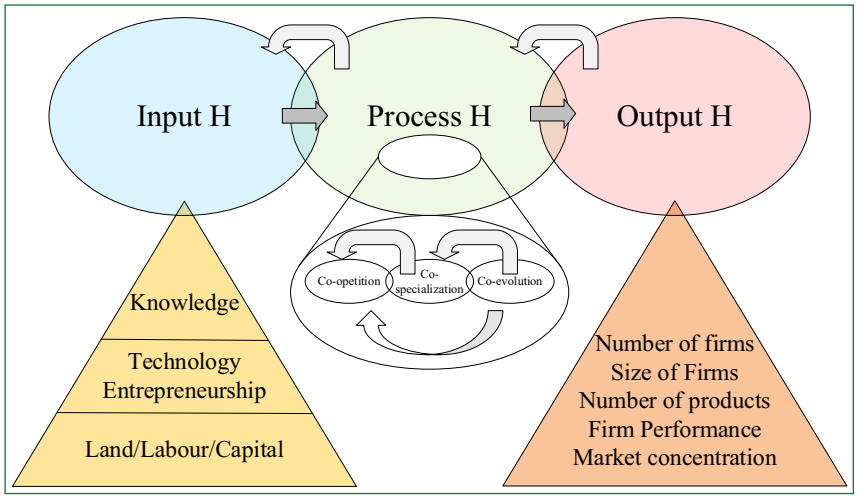
According to Carayannis and Sipp (2010), innovation and SKARSE may lead to increased competitiveness. Carefully implemented innovation policies can trigger increased innovation at the firm level and trigger a chain reaction toward more macro levels and culminate in improved competitiveness.

At a firm level competitiveness focuses on market share, whereas national competitiveness may be considered as the capability of national economies to achieve sustained economic growth, by efficiently allocating available resources (human and natural resources, capital) and having the appropriate structures, institutions, and policies. In this context, competitiveness of nations is defined as "how nations create and maintain an environment which sustains the competitiveness of its enterprises" (IMD, 2003), whereas numerous other alternative definitions may be found in the literature.

Innovation, productivity and competitiveness

Innovation-driven competitiveness is critical for a long run economic performance in today's knowledge-based global economy. When studying IPC, significant overlaps may be observed, mainly because these concepts are inherently linked (Carayannis and Grigoroudis, 2012) and thus, researchers focus on studying their drivers and outcomes, for example, in a cause and effect way (Jansen, 2006).

Methods for measuring innovation include approaches based on both single (e.g., R&D expenditures, number of patents) and composite indicators. Because a single indicator can provide only a limited view of such a broad concept, the role of composite indicators has been significantly increased in recent decades (Paas and Poltimäe, 2010). In this context, the relevant literature reveals two major approaches:



Source: Carayannis and Provance (2008)

Figure 2: Heterogeneity dynamics—input, process, output

- Evaluation of national performance and ranking of countries; and
- Analysis of National Innovation Systems.

The first approach mainly focuses on a comparative analysis of different aggregated innovation measures, whereas the second approach characterizes only a particular counter and puts emphasis on the factors that may impact innovation performance. The most widely used composite innovation index is provided by the European Innovation Scoreboard (EIS). The EIS 2015 consists of three main blocks, eight innovation dimensions, capturing in total of 25 different indicators.

Productivity measurement was initially based on a production function context and linked with economic growth, whereas in other research (see, for example, Carayannis and Grigoroudis, 2012), it integrates the theory of the firm, the index number theory, and available national accounts (OECD, 2001). Alternative productivity measures may be found in the relevant literature and these different productivity measures are classified according to the following criteria:

- Number of factors: This categorization includes single factor productivity, and multi-factor productivity, where a bundle of inputs is considered.
- Type of output measure: The alternative categories refer to either gross output or value added.

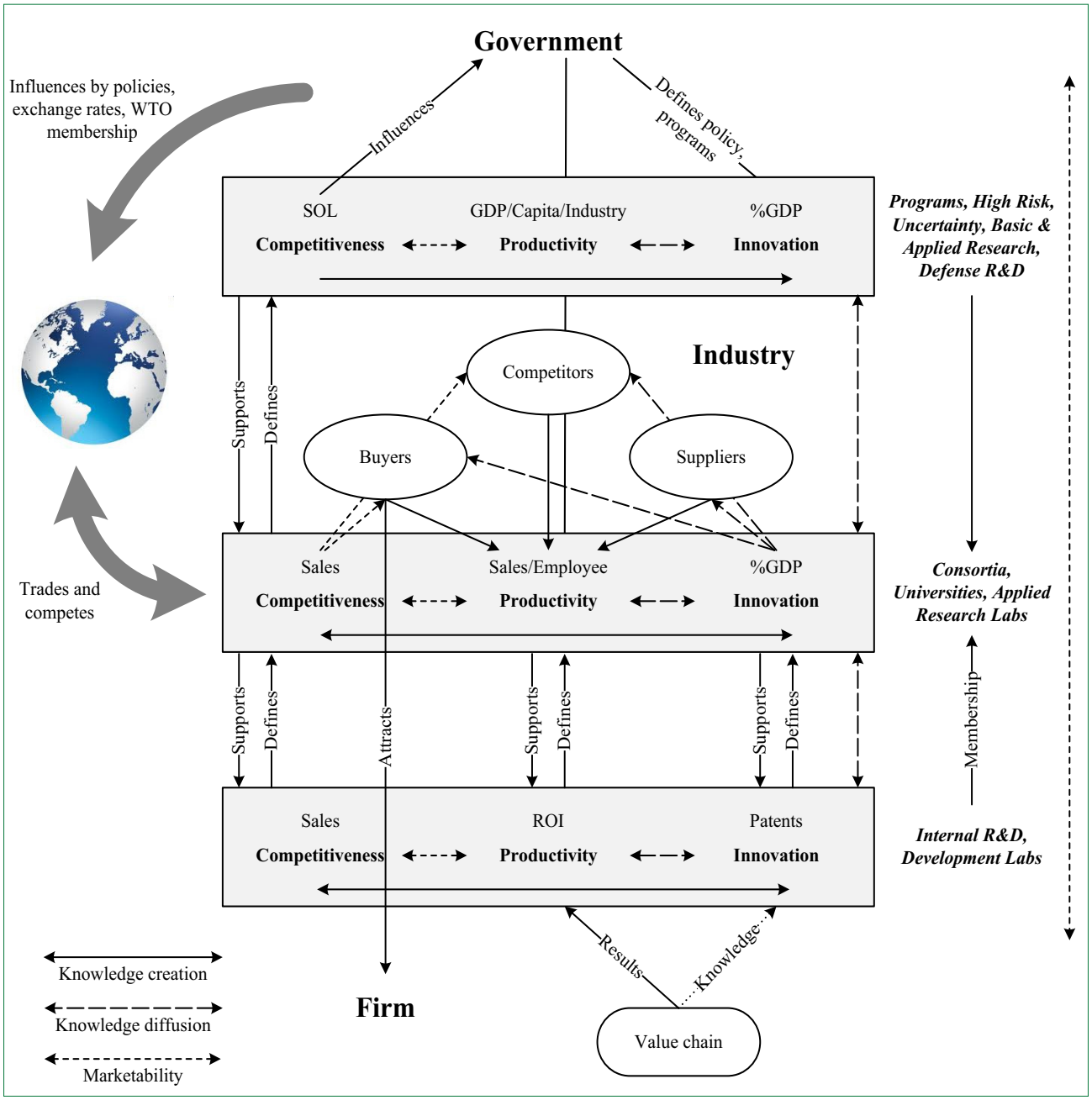
Many scholars argue that labor productivity is the most useful productivity measure because it is related with the most important factor of production, it can be easily measured, and it is a key determinant of living standards (OECD, 2001). However, it captures only partially the different aspects of this concept, and thus multi-factor productivity is usually considered.

The concepts of productivity and competitiveness seem inherently related, given that competitiveness is considered as the capability of national economies to achieve sustained economic growth, by efficiently allocating available resources. In addition, World Economic Forum (WEF, 2012) defines competitiveness as "the set of institutions, policies, and factors that determine the level of productivity of a country." Thus, in several cases, productivity is considered as the only meaningful concept of national competitiveness, and as a result the gross national product

(GNP) per capita may be used as a reliable performance index, only when a single measure should be considered. The most important efforts for developing a competiveness measurement framework refer to the global competitiveness index (GCI) developed by the WEF and the World Competitiveness Yearbook (WCY) provided by the International Institute for Management Development (IMD).

The measurement techniques adopted by the major IPC barometers are mainly based on simple estimation techniques, because a weighted average formula is usually adopted. Composite indicators are still the best tool available for analyzing such complex concepts (Paas and Poltimäe, 2010). In addition, the interrelations among these concepts are rather strong. All these justify the necessity of developing new measurement frameworks that are able to study IPC composite indices.

Moreover, the concepts of national IPC appear to have overlaps and/or significant interrelations. The relevant literature shows that, usually, these concepts are jointly studied in a firm, industry, or country level. In addition, several studies include other related aspects, like creativity and entrepreneurship (Carayannis and



Source: Carayannis and Sagi (2001)

Figure 3: The CPI model

Gonzalez, 2003) that increase the difficulty of analyzing the linkages among IPC.

The linkage between innovation and productivity/competitiveness is relatively strong, as emphasized by numerous studies (Carayannis and Sagi, 2001). Technology appears as a key factor which, through innovation, may influence the economies of scale, the timing of processes, and the introduction of new methods, and thus affect the competitive advantage of firms. Discussing these interrelations, Carayannis and Sagi (2001) emphasize that innovation and competitiveness are intrinsically unified; although one does not cause the other, both are necessary for competitiveness and for each other.

A similar linkage regarding competitiveness and productivity is also discussed in the literature. In fact several researchers emphasize that national productivity is the only meaningful concept of competitiveness. On the other hand, innovation without productivity is insufficient to produce wealth and increase national competitiveness. Thus, productivity appears inherently related with innovation and competitiveness in a country level, because it is the root cause of national capital income. Consequently, although the strength of linkages among IPC may vary depending on the level of analysis, these interrelations are adopted by numerous studies.

In the Operation Research/Management Science (OR/MS) literature these concepts are usually studied in a cause-and-effect way, adopting a Data Envelopment Analysis (DEA) approach. A characteristic holistic approach is given by Carayannis and Sagi (2001, 2002) who argue that these linkages may be observed both horizontally and vertically, sharing factors and resources such as funding, knowledge, and signals. Figure 3 presents the CPI model proposed by the authors, where national productivity results not only from national innovation programs, but also from industrial productivity, university structures, government policies, and so forth.

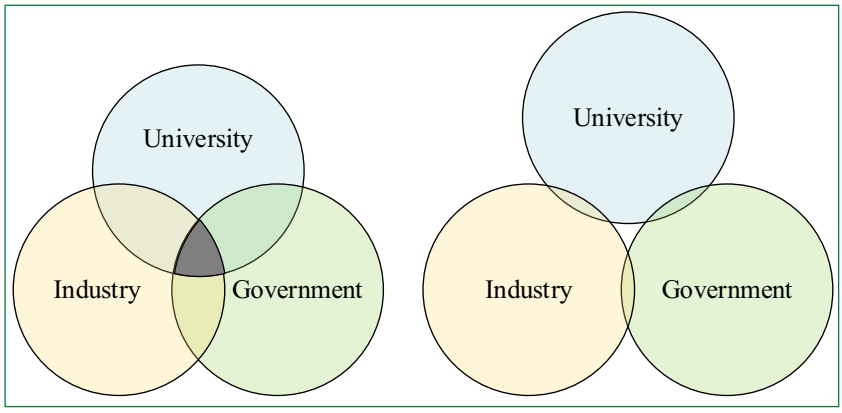
Carayannis and Grigoroudis (2012) published a work, estimating aggregated national innovation, productivity, and competitiveness indexes, based on a set of relevant indicators that describe the various aspects of these concepts. Their approach assumes that innovation may improve national productivity, which in turn gives the ability to compete on the global marketplace. Carayannis and Grigoroudis (2015) extended their work and adopted a regression-based multi-objective non-linear program (MONLP). The main characteristic of the model is that because of its multiple objective nature, it both minimizes the estimation errors and maximizes the correlation between the aggregated IPC indexes. Moreover, the MONLP model is a non-parametric approach, and thus no assumptions for the statistical properties of the examined variables are posed. In addition, the weights of the aggregation formula do not follow an arbitrary equal weighting scheme, but they are estimated based on the previous multiple objectives. Other important advantages include the flexibility of the model to consider additional desired properties for the examined variables and its ability to perform a dynamic analysis based on complete time series data.

From triple helix to quadruple innovation model

European Commission promotes the role of the multi-annual Research and Innovation Strategies for Smart Specialization (RIS3). Researchers and practitioners generally agree about the importance of building research and innovation strategies based on the involvement of local and regional bodies, businesses, social partners, and other organizations. The so-called Triple Helix model is a formalized concept behind such interactive systems (Carayannis and Campbell, 2010).

The Triple Helix concept has also been used as an operational strategy for regional development and to further the knowledge-based economy (Leydesdorff, 2012). The established Triple Helix model is a strong environment of parallel relationships between (national or regional) authorities, the wider business community (industry), and academia (including other research focused institutions). This approach places more emphasis on the role of each one of these categories of actors in the innovation process. As noted by Leydesdorff (2012), Triple Helix is a dynamic model and alternates between a number of bilateral or trilateral coordination spheres (Figure 4).

The Quadruple Innovation Helix bridges social ecology with knowledge production (Mode 3) and innovation. The most important constituent element of the quadruple helix – apart from the active "human agents"—is the resource of knowledge, which through a circulation known as circulation of knowledge, between social subsystems, changes to innovation and know-how in a society and for the economy. The Quadruple helix, thereby, visualizes the collective interaction and exchange of knowledge



Source: Carayannis and Rakhmatullin (2014)

Figure 4: A triple helix configuration with negative and positive overlap among the three subsystems

in a state by means of the following four subsystems:

- Education System in reference to academia, universities, higher education systems and schools (human capital);
- Economic System consists of industry/industries, firms, services, and banks (economic capital);
- Political System formulates the direction of where the state/country is heading in the present and future, laws, etc. (political and legal capital); and
- Civil Society (media-based–culture-based) integrates and combines two forms of capital: culture-based public-tradition values etc. (social capital) and media-based public-television Internet newspapers (capital of information).

Quadruple Helix Innovation models place a stronger focus on cooperation in innovation, and in particular, the dynamically intertwined processes of co-opetition, co-evolution, and co-specialization, within and across regional and sectoral innovation ecosystems that could serve as the foundation for diverse smart specialization strategies. The European Commission RIS3 guide outlines a set of general principles as to how S3 strategies should be developed at the regional level and recognizes the significance and need for the Quadruple Innovation Helix approach by proposing to add a fourth group to a classical Triple Helix model.

This Quadruple Helix model puts innovation users at its heart and encourages the development of innovations that are pertinent for users (civil society). Users or citizens here own and drive the innovation processes. Arnkil *et al.* (2010) maintain that the degree of user involvement could be defined as inclusive of the "design by users". In line with this perspective, new innovative products, services, and solutions are developed with the involvement of users in their role as lead users, co-developers, and co-creators (Afonso *et al.*, 2010; Carayannis, 2001). The citizens not only would be involved in the actual development work, but also would have the power to propose new types of innovations, which then connect users with their stakeholders across industry, academia, or government (Arnkil *et al.*, 2010). In turn, the role of actors in the other three helices would be supporting citizens in such innovation activities (e.g., to provide tools, information, development forums, and skills needed by users in their innovation activities). Furthermore, industrial players and public sector stakeholders would then be able to exploit the innovations developed by citizens.

The RIS3 approach also maintains that through application of horizontal forms of multi-governance, the smart specialization approach is helping regions to upgrade their research and innovation strategies based on a number of key principles including the implementation of multi-level governance and the Quadruple Helix approach. By applying the Quadruple Helix approach in the context of RIS3, regional policy makers are more likely to enable a place-based entrepreneurial process of discovery, which would generate intensive experimentation and discoveries. Such direct addition of users in the innovation process is a necessary organizational counterpart of an open and user-centered innovation policy as it allows for a greater focus on understanding underlying consumer needs (European Commission, 2012).

Quadruple helix as an architectural innovation blueprint to support RIS3

As mentioned earlier, the Quadruple Helix concept brings together four sectoral perspectives with a focus on the institutional, regional, and operational functionalities and complementarities of these sectors in the context of the knowledge economy. The overall RIS3 context provides an appropriate operationalization framework for embedding the concept in both policy and practice.

The Quadruple Helix concept thus can serve as an architectural innovation blueprint that engages simultaneously (in a dynamically balanced top-down and bottom-up approach) four sectoral perspectives (from the top-down angle government, university, industry, and the bottom-up angle civil society). The inter-sectoral and intra-sectoral as well as the inter-regional and intra-regional knowledge and learning interfaces that are embedded in the Quadruple Helix architectural blueprint determine its efficacy and sustainability. A combination of these four perspectives aims for the conceptualization, contextualization, design, implementation, and evolution of (smart, sustainable, and inclusive) growth-driving entrepreneurship and innovation ecosystems (as well as clusters, networks, and other agglomerations) at the regional level.

Civil society as the fourth pillar of the Quadruple Helix blueprint represents bottom-up actions and views of the civil society. However, to benefit from these, policymakers should ensure mechanisms such as crowd-sourcing and crowd-funding capabilities in instruments and initiatives included in their regional RIS3 strategies. Embedding these elements may allow for faster, broader, cheaper, and more resilient learning, learning-to learn, and learning-to-learn-how-to-learn dynamics (Carayannis, 2001). In addition, the social networking capabilities enacted via the fourth pillar would enhance the likelihood and impact of knowledge serendipity and knowledge arbitrage events (happy accidents). These happy accidents would then act as triggers, catalysts, and accelerators of exploration and exploitation dynamics that could substantially empower any Quadruple Helix RIS3 strategy (Carayannis *et al.*, 2008).

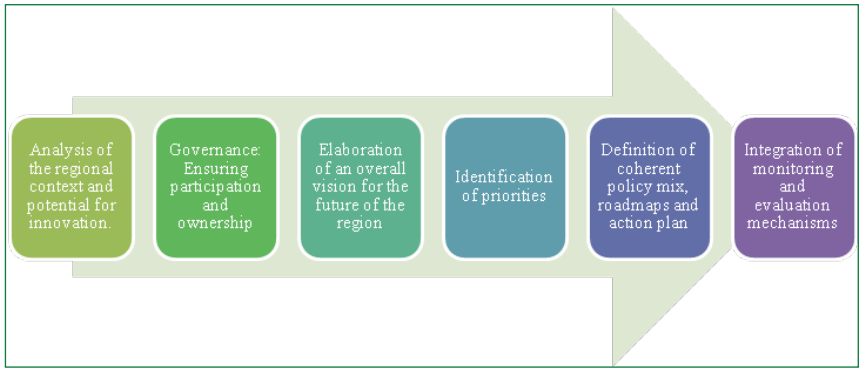
Principles of smart specialization

In the context of Europe 2020, smart specialization emerges therefore as a key element for place-based innovation policies and can be defined through the following five principles (Foray and Goenaga, 2013):

1. ***Granularity***: Smart specialization policy should concentrate on activities instead of sectors or firms. An example is the case of companies exploring the potentials of nanotech, to improve the operational efficiency of the pulp and paper industry. In such a case, the priority is not the pulp and paper sector as a whole, but rather the activity involving the development of nanotech applications for the pulp and paper industry. Targeting the development of new activities allow the government to

achieve two things through the same policy: it improves the general performance of the sector, while at the same time building capabilities and expanding the knowledge base toward new fields (Foray and Goenaga, 2013).

2. ***Entrepreneurship discovery***: The second novel insight is the process of entrepreneurial discovery. According to the business theory advanced by Kirzner entrepreneurs are continually searching for, identifying and evaluating new business opportunities and this process is called entrepreneurial discovery, which at the regional level is what regional policy makers should do, focusing on the activities instead of sectors. The policy makers should search for the entrepreneurial knowledge and discoveries to realize a regional or national vision. They should be able to differentiate between simple innovation and discoveries that have the potential to generate new areas of specialization and that might constitute the cornerstone of smart specialization.
3. ***Specialized diversification***: The third principle is that the priorities emerging today will not be supported forever. After 4 or 5 years "new activities" are no longer new. Whether they have failed or whether they have successfully reached maturity, they should no longer be priority for the smart specialization strategy.
4. ***Experimentalism***: The fourth new notion is experimentalism. There is no guarantee of success in any particular action; indeed, some actions will lead to failure. Smart specialization relies on the theories of experimental learning and it develops the idea of self-discovery elaborated by Hausmann and Rodrik (2003). According to the argument, innovation policy needs to allow for experiments to discover what works and what does not work in a particular context. Failures must also be noted to identify success. The idea of discovery and experimentation points to the role of indicators and evaluations.
5. ***Inclusive strategy:*** Smart specialization needs to be inclusive. This does not mean that the strategy will support a project in every sector but inclusive smart specialization means giving every sector a chance to be present in the strategy through a good project.



Source: European Commission (2012)

Figure 5. Six steps to a successful smart specialization strategy

One way to understand the smart specialization strategy is to look for information on how to create a successful strategy. Figure 5 presents a stepwise approach for RIS3 design.

Conclusion – examples of excellence from the nordic countries

No more Nokias

The student revolution was part of a wider reconsideration of the proper relationship between government and business. This had started in 2008 when the Finnish government shook up the universities (and created Aalto) in an attempt to spur innovation. However, it was speeded up by Nokia's problems. Finland had become dangerously dependent on this company: in 2000 Nokia accounted for 4 % of the country's GDP. The government wanted to make the mobile-phone giant's decline as painless as possible and ensure that Finland would never again become so dependent on a single company.

The Finns created an innovation and technology agency, Tekes. They also established a venture-capital fund, Finnvera, to find early-stage companies and help them get established. The center piece of their innovation system is a collection of business accelerators, partly funded by the government and partly by private enterprise, which operate in every significant area of business and provide potential high-growth companies with advice and support from experienced business people and angel investors.

As a result, Finland has become much more market-entrepreneur friendly. It has produced an impressive number of start-ups, including 300 founded by former Nokia employees. The country has also acquired the paraphernalia of a tech cluster, such as a celebratory blog (Arctic Startup) and a valley-related name (Arctic Valley).

Nokia's decline is "the best thing that ever happened to this country". The new Finland is particularly proud of its booming video-games industry, including successful companies such as Rovio Entertainment, the maker of Angry Birds and a leading supporter of the Start-Up Sauna, and Supercell, the maker of Clash of Clans.

Nordic governments recognize that they need to encourage more entrepreneurs if they are to provide their people with high-quality jobs, and that they can no longer rely on large companies to generate business ecosystems on their own. They are creating government agencies to promote start-ups. They are encouraging universities to commercialize their ideas and generate start-ups. They are telling their schools to sing the praises of entrepreneurship. Many of the region's most interesting entrepreneurs operate at the low end of the tech spectrum, often to help parents deal with the practical problems of combining full-time work and family.

Despite all this entrepreneurial energy, the Nordic region still finds it hard to

turn start-ups into enduring companies. There are too many examples of successful entrepreneurs who have upped sticks and gone elsewhere. These include not just members of the post-war generation such as the founder of giant IKEA or the founder of Tetra Pak, but also members of the up-and-coming generation. Too many successful start-ups still choose to sell themselves to foreign multi-nationals rather than becoming local champions.

Still, there is reason to hope that the entrepreneurial boom will also produce a new generation of global champions. An example is Rovio Entertainment, with the game Angry Birds. Having produced one big hit, most games companies would have started looking for the next one, but instead Rovio set about turning Angry Birds into a brand and extending its reach. It struck licensing agreements with a range of companies to make Angry Birds-branded products, from toys to chocolate to theme parks. It raised capital from outside investors such as Microsoft, which chipped in $42 million. Rovio now has 500 employees in Finland and had a turnover of $100 million in 2011 (Carayannis and Rakhmatullin, 2014)

The Ostrobothnia case

A number of attempts have been made by researchers and policymakers to evaluate different aspects of the Triple Helix model in the context of regional innovation systems, and this can indeed be extended to cover the Quadruple Helix concept.

One example is a recent exercise carried out by the Regional Council of Ostrobothnia that initiated a project where they developed a method for measuring Quadruple Helix connectedness and gaps (Virkkala *et al.*, 2014). The results of this study would then be used as factual evidence for improving RIS multi-level governance. The S3 Guide focuses on connectedness within the Quadruple Helix and taking this conceptual perspective as a guideline for good regional governance, requiring a coherent approach. In this regard, smart specialization or S3 presents itself, not just as a continuation of what we have done already under the umbrella of RIS but rather as a way of questioning existing RIS practices and removing dysfunctional policy arrangements, which prevents growth and development.

Therefore, one of the objectives of this document is to develop a self-assessment and evaluation tool, which could be used by regional policymakers to measure their region's progress in adopting, adapting and deploying the Quadruple Helix approach in their RIS3. The Fifth Report on Economic, Social and Territorial Cohesion prepared by the European Commission (2010) also suggested improving monitoring and evaluation systems across the EU to track performance and to help fine-tune efforts as needed to guarantee that pre-defined objectives are attained in the most effective manner. This requires a clear strategic vision of what the program aims to achieve and how success will be recognized and measured. Furthermore, it also requires a greater recourse to rigorous evaluation methods – both longitudinal and latitudinal (i.e., cross-sectoral, multi-level and across time and space) – for the evaluation and continuous improvement of the formulation and implementation of QH modalities and systems in the RIS3 context. (Carayannis and Rakhmatullin, 2014)

References

- ✓ Afonso, O., S. Monteiro, and M.J.R. Thompson (2010). *A growth model for the Quadruple Helix innovation theory*, NIPE Working Paper 12, Universidade do Minho.
- ✓ Arnkil, R., A. Järvensivu, P. Koski, and T. Piirainen (2010). *Exploring Quadruple Helix: Outlining user-oriented innovation models*, Working Papers 85/2010, University of Tampere.
- ✓ Carayannis, E.G., A. Kaloudis, and A. Mariussen (2008). *Diversity in the knowledge economy and society: Heterogeneity, innovation and entrepreneurship*, Edward Elgar Publishing, Cheltenham.
- ✓ Carayannis, E.G., E. Grigoroudis, S. Sindakis, and C. Walter (2014). Business Model Innovation as antecedent of sustainable enterprise excellence and resilience, *Journal of the Knowledge Economy*, Vol. 5(3), pp. 440–463.
- ✓ Carayannis, E. and J. Sagi (2001). New vs old economy: Insights on competitiveness in the global IT industry, *Technovation*, Vol. 21(8), pp. 501–514.
- ✓ Carayannis, E.G. (2001). *The strategic management of technological learning: Learning to learn and learning to learn-how-to-learn as drivers of strategic choice and firm performance in global, technology-driven markets*, CRC Press, Boca Raton, Florida.
- ✓ Carayannis, E.G. and C.M. Sipp (2010). Why, when and how are real options used in strategic technology venturing? *Journal of the Knowledge Economy*, Vol. 1(2), pp. 70–85.
- ✓ Carayannis, E.G. and D.F.J. Campbell (2009). 'Mode 3' and 'Quadruple Helix': Toward a 21st century fractal innovation ecosystem, *International Journal of Technology Management*, Vol. 46(3/4), pp. 201–234.
- ✓ Carayannis, E.G. and D.F.J. Campbell (2010). Triple Helix, Quadruple Helix and Quintuple Helix, and how do knowledge, innovation and the environment relate to each other? A proposed framework for a transdisciplinary analysis of sustainable development and social ecology, *International Journal of Social Ecology and Sustainable Development*, Vol. 1(1), pp. 41–69.
- ✓ Carayannis, E.G. and E. Gonzalez (2003). Creativity and innovation = Competitiveness? When, how and why? in: L.V. Shavinina (ed.), *The international handbook on innovation*, Elsevier Science, Boston, pp. 587–605.
- ✓ Carayannis, E.G. and E. Grigoroudis (2012). Linking innovation, productivity and competitiveness: Implications for policy and practice, *Journal of Technology Transfer*, Vol. 39(2), pp. 199–218.
- ✓ Carayannis, E.G. and E. Grigoroudis (2015). Using multiobjective mathematical programming to link national competitiveness, productivity and innovation, *Annals of Operations Research* (accepted).
- ✓ Carayannis, E.G. and J. Sagi (2002). Exploiting opportunities of the new economy: Developing nations in support of the ICT industry, *Technovation*, Vol. 22(8), pp. 517–524.

- ✓Carayannis, E.G. and M. Provance (2008). Measuring firm innovativeness: Towards a composite innovation index built on firm innovative posture, propensity and performance attributes, *International Journal of Innovation and Regional Development*, Vol. 1(1). pp. 90–107.
- ✓Carayannis, E.G. and R. Rakhmatullin (2014). The Quadruple/Quintuple Innovation Helixes and Smart Specialization Strategies for sustainable and inclusive growth in Europe and beyond, *Journal of the Knowledge Economy*, Vol. 5(2), pp, 212–239.
- ✓European Commission (2010). *The fifth report on economic, social and territorial cohesion: The future of cohesion*, European Union, Brussels.
- ✓European Commission (2012). *RIS3 guide*, European Union, Brussels.
- ✓European Commission (2014). *Smart specialization and Europe's growth agenda*, European Union, Brussels.
- ✓Foray, D. and X. Goenaga (2013). *The goals of Smart Specialization: S3 policy brief series*, JRC Scientific and Policy Reports, European Commission, Brussels.
- ✓Foray, D., J. Goddard, X.G. Beldarrain, M. Landabaso, P. McCann, K. Morgan, C. Nauwelaers, R. Ortega Argilés, and F. Mulatero (2012). *Guide to Research and Innovation Strategies for Smart Specialisations (RIS 3)*, European Union, Brussels.
- ✓Hausmann, R. and D. Rodrik (2003). Economic development as self-discovery, *Journal of Development Economics*, Vol. 72(2), pp. 603–633.
- ✓IMD (2003). *World competitiveness yearbook 2003*, Institute for Management Development, Lausanne.
- ✓Jansen, J.J.P., (2006). Exploratory innovation, exploitative innovation and performance: Effects of organizational antecedents and environmental moderators, *Management Science*, Vol. 52(11), pp. 1661–1674.
- ✓Leydesdorff, L. (2012). The Triple Helix, Quadruple Helix, …, and an N-Tuple of Helices: Explanatory models for analyzing the knowledge-based economy, *Journal of the Knowledge Economy*, Vol. 3(1), pp. 25–35.
- ✓Midtkandal, I. and J. Sörvik (2012). What is smart specialisation? *Nordregio News*, 5, http://www.nordregio.se/en/Metameny/Nordregio-News/2012/Smart-Specialisation/Context
- ✓OECD (2001). *Measuring productivity: Measurement of aggregate and industry-level productivity growth*, OECD Publications, Paris.
- ✓Paas, T. and H. Poltimäe (2010). *A comparative analysis of national innovation performance: The Baltic States in the EU context*, Working Paper 78, University of Tartu, Faculty of Economics and Business Administration, Tartu.
- ✓Virkkala S., A. Mäenpää, A. Mariussen, (2014). *The Ostrobothnian model of smart specialization*, Proceedings of the University of Vaasa, Reports 195, http://www.uva.fi/materiaali/pdf/isbn_978-952-476-577-0.pdf.
- ✓WEF (2012). *The global competitiveness report 2012–2013*, World Economic Forum, Geneva. ■

Measuring smartness of innovation policy

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Abstract

The "smart specialisation" is a concept introduced for enhancing innovation in the European Union (EU). Smartness lies in entrepreneurial discovery of areas of specialisations that best fit innovation potential of the territory. Smartness is studied at meso level as an area of horizontal overlaps between three domains of knowledge triangle: education, research, and innovation. Overlap is measured with correlation of evaluated policy instruments' impacts on three evaluation domains. Case study suggests that vertical and horizontal, or "dumb" and "smart" aspects of innovation policy are both important for policy success. This suggests a new policy concept of country's specialisation in innovation that is not merely smart but fully mesoscopic.

Challenge

The "smart growth" and the "smart specialisation" are concepts in new strategic approach (*Midtkandal and Sörvik*, 2012) introduced by European Commission for enhancing innovation as leading driver of welfare progress in EU (COM(2006)-604). The new concept replaces the traditional vertical silos approach (Degani, 2014) with only one way flow (Sjoer et al., 2012), from single sectoral challenge to single sectoral solution, neatly organized each in its own ministry or department, favouring particular technologies, fields and firms. Sector-based specialisation implies top-down approach in which country identifies a limited number of priority areas for knowledge-based investments and concentrates existing capabilities, assets, competences and comparative advantages with the aim to enhance innovative capacities. These materialise through linear progression from basic research to education and laboratory work, innovation and commercialisation. As a result, innovators, scientists and researchers often even exclude one other from the use of the innovation to appropriate larger fraction of the benefits (Foray and Goenega, 2013). The new concept therefore shifts deep understanding and changes mind-set (Lappalainen and Markkula, 2013) from silos to cross-organisation model which is based on both ways or circular connectedness (Degani, 2014) between sectors of innovation policy.

Smartness is an alternative strategy to old style sector-based specialisation. If you are small, you are not in a good position to benefit from concentration and returns to size and so you have to be smarter (Foray and Goenega, 2013). Smartness refers to learning process, where stakeholders play a key role in discovering areas of future specialisation from the bottom-up approach (COM(2006)-604). Smartness lies in innovative "entrepreneurial discovery" (Foray, 2013) of the specialisation that best fits specific potential of the territory, based on local assets and capabilities, regardless of whether the concerned territory is traditionally strong in innovation or weak, high-tech or low-tech (*Midtkandal and Sörvik*, 2012).

Smartness emphasizes horizontal logic (Foray and Goenega, 2013) of specialisation. It seeks for synergies between independent drivers of innovation and emphasises that its various sectors should support each other – only indirectly but strategically. Smartness of specialisation in innovation can be formalised with a concept of "knowledge triangle" (KT) as proposed by European Institute for Technology (EIT) in 2008 (see COM(2006)-604). The Triangle underlines the interaction between research (R), education (E) and innovation (I) as three main sectors, domains, pillars, drivers or capitals of a knowledge-based society (Schuch, 2013). Each sector brings forward essential concerns for innovation policy, which are specific for one sector individually and these concerns remain mostly ignored in other sectors. For instance, companies are primarily concerned with innovation because of higher profit and income; education sector in its core is constituted on autonomy; research sector is devoted to enhancement of predictive powers of knowledge (Lappalainen and Markkula, 2013). Separate missions of each knowledge domain justify vertical and sector-based organisation of innovation policy.

Therefore, smart innovation policy needs to be understood and governed along two "axes": the vertical one which is illuminating sectoral concerns (E, R or I), and the horizontal one which is presenting inter-sectoral overlaps between I, E and R as areas of policy "orchestration" (Sjoer *et al.*, 2012). Horizontal perspective is relevant because, despite contradictions in their core, E, R and I tend to stimulate and cross-fertilise each other (Carvalho, 2010). Smart specialisation and KT are two concepts that both highlight the importance of jointly fostering innovation in many independent but overlapping sectors, which also calls for paying due attention to the linkages between them (Lappalainen and Markkula, 2013). For instance, horizontal overlapping

of I, E and R will give the companies opportunities to commercialise the most up-to-date research findings. In return, research organisations will benefit from additional incomes from commercialisation of their intellectual rights. Education will take advantage of linking learning with doing, providing students with better employment opportunities and furthering their professional competencies.

Pursuing smart (specialisation of) innovation is paramount challenge along both axes in EU, compared to its main competitors. In vertical direction, there is insufficient concentration of knowledge resources in poles of excellence. The policy aim is specialisation but also avoiding the government failures associated with the top-down bureaucratic technology choices (Foray and Goenega, 2013). Furthermore, in KT there is not only one vertical perspective but also many that shall be coordinated with their incompatible demands.

Barriers to horizontal smartness are also profound in EU. They stand in the way of spreading new knowledge (Mulgan, 2007) between three sectors of KT, between public and private stakeholders as well as between theory and practice. There is insufficient commercial exploitation of (publicly funded) research; insufficient trans- and inter-disciplinary research with insufficient focus on medium- and long-term social challenges; lack of innovative governance; cultural differences between science and private companies, legal barriers, as well as fragmented knowledge and technology markets.

When measuring smartness, we are not, of course, aspiring to find out how innovative the outputs, results (outcomes) and impacts of innovation policy really are but only how they, as they are, overlap and support each other. Traditionally, evaluation of innovation policy's impacts adopt a simplistic model of results based assessment, essentially trying to understand what happened as a result of interventions and then connecting this back to programme goals (Reid, 2010). Simplistic models that assume a direct-cause effect relationship, such as a return on investment of R&D funding, many times fail to represent the innovation appropriately (Reid, 2010). Linear theory of change in impact evaluation raises number of methodological issues when faced with complex social challenges. Insightful example is the attribution problem: how to assess a change in a policy variable caused by the intervention when change emerges from overlap between different independent causes. Causality cannot explain much in evaluation when asking complex questions. All one can usually find out is correlation between independent evaluation domains and this does not allow for strong and definite conclusions but only for weak and contextually valid ones. Another examples of basically the same difficulty linked to non-linearity are aggregation and integration problems in evaluation (Radej, 2013, 2014a).

In innovation policy, linear thinking must be replaced with complex one which is elaborated at meso level, since it allows for logical consistency between partly independent and partly interwoven structures of generating and applying knowledge (Zenker and Muller, 2008) that involve interactive, collaborative and thus non-linear thinking (Hirvikoski, 2013; Reid, 2010; RISS, 2011). We accordingly hypothesise that innovation policy should be implemented and its impacts evaluated in mesoscopic way that is partly in sectoral perspective ("dumb", vertical) and partly in intra-sectoral (smart, horizontal) perspective.

The second chapter presents "The three capital model" (3C; Radej, 2014a) as the mesoscopic approach to measuring smartness of innovation policy. The 3C model is abbreviated version of "The four capital model" of sustainable development (4C: economic, social, environmental, human; Ekins, 1992; Ekins and Medhurst, 2006). The difference between 3C and 4C approach is not essential in evaluation methodology. What is important is distinction between one (usually economic) and many, and thus between simple and complex approach.

The third chapter introduces experimental policy impact evaluation case study on which newly proposed methodology is tested. The fourth chapter presents evaluation results and the fifth discusses about them. This article concludes with recapitulation.

Model

Innovation policy have been traditionally evaluated using simplistic models in which challenges are presented with parallel vertical pillars of independent evaluation domains, in our case E, R, and I. The simplistic model is operationalised with three sets of independent evaluation criteria for each innovation sector separately – such as with innovation scorecards (IUS, 2011). This is effective approach for emphasising selected key aspects of innovation policy for each sector, such as patent activity, scientific papers' citation or number of PhD students in natural sciences. Yet this kind of evaluation cannot tell anything about policy smartness since the model is lacking even the slightest horizontal overlap between innovation sectors.

The European Institute for Technology (EIT) originally conceptualized KT in a systemic way, in which three pillars are connected with lines into triangle. Markkula (Lappalainen and Markkula, 2013) went step further and modelled KT with Sierpiński triangle, with smaller triangles embedded into larger triangle. This is, formally speaking, chaotic presentation (Radej, 2014b) where KT is modelled on lower level with three smaller triangles applied as fractals — a geometric figure that does not become simpler when you analyse it into smaller and smaller detail (Baranger, 2001). On the top of presentation he placed a triangle of horizontal "orchestration" that is connecting three domains of KT, not with lines or overlaps between them, but with scale invariant replication of the same, triangular form on all levels of evaluation.

What connects two models is that they are not complex, but simple (vertical, linear) or chaotic (horizontal, non-linear; Radej, 2014b) schematisations. Simple and chaotic approaches are nevertheless relevant since complex approach lies precisely between them. Complex understanding is modelled in hybrid way — as partly simple and partly chaotic system (Stacey, 2002), that shares characteristics of both: smart specialisation is partly ordered linear (sector based), and partly disordered non-linear (inter-sectoral) phenomenon.

Radej (2014b) proposed to present hybrid concept of complexity with Venn diagram (1880) and its three partly overlapping circles. Non-overlapping areas of Venn diagram present three pillars or integral domains of KT that are equally important for innovation policy, but vertically incommensurable. One cannot for instance aggregate detailed E, R and I impacts into an indicator of summary impact because they are not commensurable. They are expressed in different common denominators, like money, number of patents and employment, so they can be aggregated only partially and separately each in its own domain. On the other side, overlapping areas refer to inter-sectoral impacts that are hybrid in nature so they can be aggregated with correlation into summary indicator of impact. Presentation of complex structure with Venn diagram is appropriate since it combines opposite perspectives (sectoral vs. inter-sectoral) in coexistence without logical contradiction (Flores-Camacho *et al.,* 2007*)*.

In selected case study we start evaluation of innovation policy's smartness with constructing conventional Leopold (1971) impact matrix which presents detailed impacts of each policy instrument on each evaluation criteria. In the second step, detailed impacts are partially aggregated by source (policy instruments) and area of impact (evaluation criteria) into Leontief (1970) square input–output matrix. It displays how three domains of KT impact each other in sectoral and in inter-sectoral way. In the next step, non-diagonally located inter-sectoral impacts are correlated in two phases: first as an overlap between two sectors (circles) and then in triadic overlap between three binary overlaps. Non-overlapping areas in Venn diagram evaluate sectoral aspect of innovation policy, while overlapping areas are explaining smartness of innovation policy.

Data

Mesoscopic approach has been tested in mid-term evaluation of selected innovation policy instruments that comprise many of the most transforming segments of KT in Slovenia from the aspect of their relevance, efficiency, effectiveness, and nine horizontal criteria (Table 1). Ministry for higher education, science and technology allocated almost 220 mil € in 2007–2011 while companies contributed additional 57 mil € in own financing, which together accounted to 0.8% of annual GDP (while R&R expenditure in 2010 reached 2.11% GDP; MK Projekt *et al.*, 2012). Eight instruments have been implemented as parts of two national Operational Programs — for Regional Development (RD) and for Human Resources Development (HRD):

- "Strategic research in companies" (SR; RD) co-finances developing knowledge, prototype or essential improvement on technological platform that enhances access to global market.
- "Centres of Excellence" (CE; RD) concentrates knowledge and strengthen partnership by financing establishment and management of centres, their research, costs of demonstration projects and investment in R&D equipment.
- "Competence Centres" (CC; RD) co-finances management and development of centres for accomplishing joint R&D, industrial research and experimental development.
- "Young researchers" (YR; HRD) finances R&D costs during study at master and PhD level.
- "Innovative Scheme" (IS; HRD) co-finances PhD students for costs of a tuition fee and attendance at international conferences.
- "Career Centres" (CA; HRD) finances Universities for connecting with R&D and companies and to improve students' access to labour market.
- "Bologna Process" (BP; HRD) aims at creating comparable University programs in EU (COM(2006)-604). Instrument finances reform of higher education programs.
- "Foreign professors and External experts" (FP; HRD) finances mobility between University, R&D institutions

Table 1: Leopold impact matrix for Slovenian innovation policy, on scale 1-5

Horizontal Evaluation Criteria		C1: Cost efficiency	G4: Regional balane	C6: Employment	C8: Business environment	G5: Gender equality	C7: Sustainability	C2: Natural environment	C3: Leverage	C9: Wider society
Policy Instruments	KT*	R	R	R	E	E	I	I	I	
YR	R	2,7	3,0	3,5	3,3	3,0	5,0	2,8	n.r.	3,4
IS	R	2,6	n.r.	3,2	3,5	5,0	5,0	3,3	n.r.	3,4
CA	E	3,4	n.r.	3,8	2,9	2,5	5,0	3,8	1,0	3,4
BP	E	3,8	2,8	3,5	3,7	3,0	4,0	2,6	n.r.	3,9
FP	E	3,0	2,8	2,2	3,2	3,0	4,0	2,6	n.r.	2,9
SR, CE, CC	I	3,2	2,6	3,1	3,1	3,0	3,7	4,2	3,0	3,1

Source: MK Projekt et al. (2012).

Notes: n.r., not relevant; *, grouping columns and rows on three domains of KT.

and companies to stimulate transfer of knowledge, cooperation and exchange.

Evaluation drew from two data sources beside official statistics. The first was provided by extensive governmental monitoring system of input data, output and also for result indicators (only incompletely) for each instruments' operation (project, scholarship, visit…). In addition to this a set of differentiated questionnaires have been prepared for each type of beneficiary — students, professors, researchers, businessmen, project managers.

Each instrument was assessed against prescribed set of nine horizontal evaluation criteria (on five-level scale, prevailingly negative impact = 1; poor positive = 2; positive = 3; strong positive = 4; excellent = 5):

- C1: Cost efficiency — beneficiaries were questioned about diverse aspects of administrative management of operations.
- C2: Instruments' impacts on natural environment (questionnaire).
- C3: Leverage effect — how much private investment is attracted per euro of public investment (monitoring data).
- C4: Regional balance of impact on 12 Slovenian regions, assessed with comparison of allocated funds per capita (monitoring data and statistical data).
- C5: Gender equality, as representation of women in financed operations (questionnaire).
- C6: Employment criterion asks if the operation increases employment opportunities (questionnaire).
- C7: Sustainability criterion asks if achievements of the project can be maintained after completion of the operation (questionnaire).
- C8: Impact on business environment regarding multidisciplinary knowledge, new opportunities, and organisational change in companies (questionnaire).
- C9: Impact on wider society — local and family needs, SMEs, professional associations, research institutions, University (questionnaire).

All assessed impacts of eight instruments by nine criteria were organized into Leopold evaluation matrix. In the next step they were grouped by rows and columns to obtain Leontief matrix presenting intersectoral impacts between three domains of KT:

- Instruments grouped into R (first row of Leontief matrix): YR, IS; Criteria grouped into R (first column): C1, C4, C6 and C8.
- Instruments grouped into E (second row): CA, BP, FP; Criteria grouped into E (second column): G5 and G7.
- Instruments grouped into I (third row): SR, CE, CC; Criteria grouped into I (third column): C2, C3 and C9.

Grouping is not optimal since logical links between domains, instruments and criteria are in some cases weak. Two reasons stand behind this. Horizontal evaluation criteria (Table 1) have not been selected by evaluators. Besides, the policy instruments have not been modelled explicitly by the concept of KT. Matching between policy design and evaluation design is therefore not optimal. For this reason the evaluation of smartness can serve as a methodological experiment, whereas its policy findings in this respect remain indicative.

Results

According to output indicators, Slovenian innovation policy has been very successful in mid-term achievements (2007–2011): 2036 projects proposals were received, 71, 5% approved and 7, 4% already completed. Some 800 students have started their PhD studies. One-hundred foreign professors and experts were involved in University programmes. Almost 370 young researchers have been employed in companies or 85% more than planned for the whole period (to 2013), 47 innovations and 22 patents registered, both exceeding goals. Planned outputs for the entire period were achieved also in number of R&D projects in SME (100%), number of research hours in full time equivalent (900%!) and in private co-financing in supported projects (153%). These achievements are correlated with strong improvement in international statistical comparisons of main innovation indicators (IUS, 2011) where Slovenia is recognized as one of the fastest growing countries in the group of innovation followers.

Next, evaluators accomplished cross-sectional assessment of instruments' impacts on evaluation criteria. Results are presented in Leopold impact matrix (Table 1).

Leverage effect appears as poor horizontal indicator since majority of instruments did not demand private financing in implementation of operations. However, evaluation found that private financing is involved in all instruments at least in costs for preparation of project proposals that broadly accounted to 2% of allocated funds (or 7% of all private financing) and should also be taken into account, but with opposite rationale.

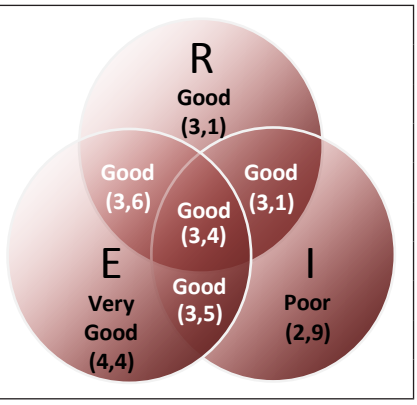
Excellent innovation policy impacts are mostly evident only in sustainability criteria, with some reservation for SR, CE, and CC (3,7). Results in majority of other evaluated criteria show only moderately favourable impacts. Impacts on regional balance are especially poor. This is problematic in light of aspirations for achieving territorial smartness of innovation policy. E, I and R are to a large extent concentrated in a small number of innovative regions, so that they increase differences between innovative and 'non-innovative' regions (but not between innovative regions). Regional concentration is strongly linked to prevailing technological character of innovation policy; 'non-innovative' regions often innovate in non-technological ways such as in new models of eco-businesses, in social economy and in cultural production, which are absent from instruments evaluated here. Thus to strengthen territorial smartness, evaluation pleaded for both more innovative design of regional policy and broader focus of innovation policy.

Instruments' vertical impacts — in sector-based perspective — are the most favourable for sector E (4,4; Table 2), whereas sector I stays observably behind (2,9), similarly also for R (3,1).

Horizontal overlaps between domains of KT are described in correlation matrix.

Table 2: Venn diagram of innovation policy's impacts, on scale 1–5

Leontief matrix			
	R	E	I
R	3,1	4,0	3,1
E	3,2	4,4	3,5
I	3,1	3,5	2,9
Correlation matrix			
	R	E	I
R	3,1	3,6	3,1
E	—	4,4	3,5
I	—	—	2,9



Source: Table 1.

E and R are correlated in strongest overlap (3,6).[1] E impacts R (3,2) regionally asymmetrically with poor contribution to improved business environment (Table 1), while R impacts E very favourably (4,0). Extent of inter-sectoral orchestration between E and I is assessed with 3,5. E is too weakly linked to private sector, whereas I is not providing sufficient guarantees to E for sustainable use of new research infrastructure (Table 1). The weakest overlap is between I and R (3,1). Impacts on sector I maintain lower regional balance, lower employment and not optimal cost efficiency. Impacts on R on the other side do not excel in efficiency and also suffer from weak employment effect (Table 1).

Overall smartness of innovation policy is assessed as good with 3,4. This summary indicator of overlap is obtained in Venn diagram as an average assessment of three binary overlaps.

Discussion

Despite excellence in KT has not been achieved in general yet, summary indicator of overlap between three domains is rather favourable pointing to smartness of (specialisation in)[2] Slovenian innovation policy from 2007 to 2011. Evaluation found that instruments have strongly enhanced cooperation between domains of KT, in particularly by RD's instruments, and especially CE. Institutions have also introduced new models of cooperation which changed stakeholders' behaviour, a clear sign for evaluation to recognise impact of policy interventions. Researchers have also changed their behaviour with initiating much stronger cooperation with companies.

Achieved smartness (3,4) is evaluated as favourable at least relative to non-overlapping, sector-based achievements (3,5), obtained as an average assessment for three pillars on diagonal of correlation matrix). Following theoretical elaboration we would expect different situation with observably stronger sectoral performance ("dumb") than inter-sectoral ("smart"). Overlaps are harder to achieve since they require new approaches to management, additional effort in coordination and developing partnership, consensus and synergies.

Achieved moderate smartness of Slovenian innovation policy is not really entirely surprising if we take into account rather specific context in which instruments were implemented — deep economic crises with close to 7% contraction in national GDP (2009–2011). Large public deficits linked to stabilisation of financial sector imposed austerity policy that shrunk public budgets of educational and research institutions. On the other side, it was increasingly hard for companies to provide funds needed to exploit new market opportunities linked to new technologies (POR 2011; Bešter and Murovec, 2010). This all led to enormous increase in number of projects that could not be implemented without public support. In this way, the Ministry has obtained strong leverage for overcoming sectoral barriers between three domains of KT and for decisive deepening inter-sectoral cooperation.

Yet, smartness of innovation policy needs to be read with caution amid observable weaknesses on the side of disappointing sectoral impacts, particularly for R and I. Very successful sectoral outputs have not been translated into very successful social-wide impacts (partly understandable because impacts emerge gradually over longer period of time). Overlaps between sectors are thus instituted on weak sectoral fundamentals and therefore vulnerable.

Favourable achievements in E are confirmed for Slovenia also in Competitiveness index (WEF, in EO, V/2011) and in OECD (2012). Sector R continues to lag behind in openness, in social responsibility in meeting societal challenges and in commercial exploitation of opportunities. Innovative companies still perform on lower level of productivity than average company nationally; share of the highest technology export remains at disappointing 5% (EO, May 2011); income from intellectual property rights remains very low (IUS, 2011). This among others suggested that innovation policy's impacts in companies could be strengthened in fundamentals by the means of conventional industrial and competitiveness policies.

[1] Correlation coefficient in statistics ranges from -1 (negative), absent (0) to +1 (positive). Correlation in Table 2 is expressed qualitatively from absent or negative (1), weakly positive to strongly positive (2–5). We are working with horizontal evaluation criteria which are by definition equally relevant for all policy instruments. In such case, absence or negative correlation are characterized as strategic problems because they wreck integrity of evaluated issue.

[2] Extent and direction of innovation policy's specialization is not measured here and remains addressed only indirectly through assessment of outcomes and impacts of policy instruments that enhance it, particularly in the case of RD instruments, YR and IS. Extent of specialization is reflected also in the assessment of sectoral achievements which are specialized by definition. More explicit address of specialization would be achieved with inclusion of indicators of specialization in Leopold matrix.

Evaluation suggests that sectoral weaknesses are linked to poor learning capacity by policy-makers about how mechanisms of innovation policy function in practice (weak theory of change), poor needs assessment of beneficiaries and market opportunities, not ambitious planning of goals and in general overshooting specific unit costs for goals achievement. One of the most systematically recurring criticism expressed by beneficiaries is that administrative management of instruments is too formalistic and meeting formal demands many times seems more important than progress in innovation (for RD in general, for YR and FP). Administrators at the Ministry are many times unwilling to adopt changes in operation even when it is obvious that improvements are feasible and justified. Beneficiaries opined that administrative management is many times unfriendly such as when calls for proposals were not announced, short application period and very demanding procedures, sometimes with weak support to applicants, sometimes with large share of justified objections, practicing long periods for funds reimbursement, and absence of prepayments. Beneficiaries were sometimes forced to accept role of passive followers of policy administrators and their understanding of innovation policy mission. This invoked opportunist behaviours in part of beneficiaries. This sort of "dumbness" in innovation policy arises superficially, as a result of overextended bureaucracy, it is not caused by narrow but nevertheless justified sector-based linear rationales in each KT domain.

In horizontal perspective it is noticeable (MK Projekt *et al.*, 2012) that overlap between instruments of RD and instruments of HRD is weaker than overlap between instruments of the same operational program. Evaluation pointed out to persisting barriers to horizontal synergies. The public research sector many times still poorly provides knowledge resources to companies in adequate quantity and quality (Foray and van Ark, 2008). WEF has observed that University programs also poorly serve needs of companies (in EO, IX/2011). Excessive disciplinary specialisation proceeds at the expense of diminishing trans-disciplinary approaches in research and training. OECD (2012) outlined problematic fragmentation of research field on small groups which cover broad spectra of activities and dispersed financing of research in Slovenia. By opinion of POR (2011), research continues to be systematically neglected at Universities and is usually understood as only supplementary activity. Universities and research institutes sometimes still consider companies as a separate, perhaps even an undesirable world, and similarly also many companies do not consider interaction with universities or other research organisations as a strategic input into their future (COM(2006)-604).

Transfer of knowledge from E and R into I is still weak (SVREZ, 2014). Achieved increased employment of researchers in companies is to a large extent linked to subsidies and could perish together with diminished public financing (POR, 2011). Flow of knowledge also needs to feedback from companies to E and R. In this regard, evaluation emphasised unused potential for involvement of experts from SR, CE and CC into E and FP for transferring their innovative experiences back to institutions of knowledge. For strengthening link from E to I, companies may need to be, according to evaluation, more involved into search for appropriate topic for PhD dissertations prepared under IS.

Imperative for strengthening horizontal overlap between domains of KT implies that innovation policy needs to be innovated with hybrid solutions. In our view relevant proposal in this regard is the concept of integrated education at a "research university" (Schuch, 2013). It makes the research-based learning the standard, educates graduate students as apprentice teachers and cultivates a sense of community of learners (Roumen and Ilieva, 2007). University involves students as co-creators of knowledge and as part of the innovation system (Lappalainen and Markkula, 2013). The students are equal partners, developing and creating new professional knowledge and skills while growing towards their own fullest potential as human beings (Hirvikoski, 2013).

Analogously, research organisations shall be strengthened especially in their intermediary function for enhancing their capacity to link new knowledge with social challenges. They have access to academic, mostly fundamental knowledge that they use and translate for the needs of their users (Zenker and Muller, 2008) in profit as well as in non-profit projects. In knowledge-based society, companies also need to enhance profitability in increasingly hybrid way — integrally with improving their social responsibility, environmental sustainability and ethical standards.

Finally, for smarter innovation policy, public sector innovation should be pursued in administration and organisation, in policy design and regulations, in service and goods delivery, in financial support and concepts (Foray and van Ark, 2008; Hollanders *et al*., 2013;). In EU, on average, two-thirds of government institutions introduced innovation in their operations during preceding 3 years (UNU-MERIT, 2011) — ranging from improved services to improved legislation — the latter being the strongest area of innovation in government. EC has introduced specific recommendations for simplification in administration, financing and implementation of Cohesion policy instruments.[3] Hollanders *et al*. (2013) estimated that companies that perceive an increase of 1 unit in the index of public administration are 13.4% more likely to use services for innovation. In addition, companies that use services for innovation are 27% more likely to innovate.

Conclusion

Policy smartness does not need to become foggy immeasurable concept, useful only for decorative political talk.

[3]http://ec.europa.eu/regional_policy/sources/docgener/informat/2014/simplification_sl.pdf

However, measuring it may require innovative approach. Old style output and result-based methodology in linear bottom-up or top-down approaches are only appropriate for assessment of specific and isolated concerns of sectors in achieving their fragmented goals, but they fail in evaluation of policy challenges that are complex in character and integrative in scope.

The case study confirms initially stated hypothesis. Measuring smartness of innovation is mesoscopic challenge since it comprises two orthogonal explanatory axes: vertical, in a sectoral perspective and horizontal between overlapping sectors of innovation policy. All sectors are equally important even though leading innovation processes in independent directions. The contradiction can be resolved at meso level of evaluation.

Foray (2013) explained that a too high level policy approach transforms policy into sectoral concern, but a too fine grained level transforms it into policy through which all projects of some merits will be funded where no specialisation can take place. The smartness in innovation policy shall be addressed at middle level and with mid-grained granularity (Foray and Goenega, 2013) just as it is suggested by triadic concept of KT. However, smartness is only an aspect of innovation challenge which suggests broadening the concept of specialisation in innovation, that is not merely smart but fully mesoscopic.

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References

✓ Baranger M. (2001). Chaos, Complexity, and Entropy: A Physics Talk for Non-Physicists. Cambridge: New England Complex Systems Institute.

✓ Bešter J., N. Murovec N. 2010. Spremljanje inovativnosti slovenskih podjetij. Ljubljana, Inštitut za ekonomska raziskovanja

✓ Carvalho M. (2010). Green Knowledge Triangle. http://www.gracacarvalho.eu/

✓ Degani M. (2014). New "Horizons" of the Knowledge Triangle. Krakow.

✓ EC. Proposal for a Regulation of the European Parliament and of the Council on the European Institute of Technology. IMPACT ASSESSMENT—integrating ex ante evaluation requirements. Commission Staff Working Document, COM(2006)-604 final

✓ Ekins P. (1992). A Four-Capital Model of Wealth Creation in Real-Life Economics: Understanding Wealth Creation (in Ekins P., M. Max-Neef, eds.). London, New York: Routledge, pp. 147–55.

✓ Ekins P., Medhurst J. The European Structural Funds and Sustainable Development: A Methodology and Indicator Framework for Evaluation. Sage: Evaluation, 12/4(October 2006):474–95.

✓ EO—Ekonomsko ogledalo UMAR (Slovenian Economic Mirror, IMAD). Ljubljana: UMAR, September 2011.

✓ EO—Ekonomsko ogledalo UMAR (Slovenian Economic Mirror, IMAD). Ljubljana: UMAR, May 2011.

✓ Flores-Camacho F., Gallegos-Cazares L., Garritz A., Garciá-Franco A. Incommensurability and Multiple Models: Representations of the Structure of Matter in Undergraduate Chemistry Students. Springer, Science & Education 16(2007):775–800.

✓ Foray D. (2013). Measuring smart specialisation: entrepreneurial discovery, new activities and inclusiveness. Provinciehuis Groningen: S3 Thematic Workshop.

✓ Foray D., X. Goenega. The goals of smart specialisation. JRC-IPTS—S3 Platform, Policy Brief Series no 1/2013 (May).

✓ Foray D., B. van Ark. (2008). Overview on Knowledge for Growth: European issues and policy challenges in EC. Knowledge for Growth. European Issues and Policy Challenges. European Commission, Directorate-General for Research.

✓ Hirvikoski T. (2013). The Knowledge Triangle. Promoting Innovation and Multidimensional Learning, in Lappalainen, Markkula.

✓ Hollanders H., A. Arundel, B. Buligescu, V. Peter, L. Roman, P. Simmonds, N. Es-Sadki. (2013). European Public Sector Innovation Scoreboard 2013. EC—Direcorate-General for Enterprise and Industry

✓ IMD World Competitivness Yearbook (2011). Lausanne: IMD World Competitiveness Center.

✓ IUS. (2011). The Innovation Union's performance scoreboard for Research and Innovation. European Commission, EC- Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs.

✓ Lappalainen P., M. Markkula (eds). (2013). The Knowledge Triangle—Re-Inventing the Future. European Society for Engineering Education, SEFI.

✓ Leontief W. Environmental Repercussion and the Economic Structure: An Input-Output Approach. Cambridge Mass.: The MIT Press, Review of Economics and Statistics, 52/3(1970):262–71.

✓ Leopold L. B., F. E. Clarke, B. B. Hanshaw, J. R. Balsley. (1971). A Procedure for Evaluating Environmental Impact. Washington: Geological Survey Circular 645.

✓ Markkula M. (2013). The Knowledge Triangle Renewing the University Culture in Lappalainen, Markkula.

✓ Midtkandal I., J. Sörvik (2012). What is Smart Specialisation? Nordregio News Issue 5.

✓ MK Projekt, Greta Associati, Metis, B. Radej, M. Dolinšek (2012). Vrednotenje ukrepov za spodbujanje raziskovalno razvojnih aktivnosti v gospodarstvu in institucijah znanja (Mid-term evaluation of measures for stimulation of research and development activities in companies and in institutions of knowledge). Ljubljana, Final report.

- ✓ Mulgan G. (2007). Ready or not? Taking innovation in the public sector seriously. Nesta—National Endowment for Science, Technology and the Arts.
- ✓ OECD. (2012). OECD Reviews of Innovation Policy: Slovenia. Paris: OECD Publishing.
- ✓ POR. (2011). Poročilo o razvoju 2011 (Development Report IMAD). Ljubljana: Urad za makroekonomske analize in razvoj.
- ✓ Radej B. Apples and Oranges: Synthesis without a common denominator. Ljubljana: Slovenian Evaluation Society, Working Papers, 7/1(February 2014a).
- ✓ Radej B. Social Complexity: Operational definition. Slovenian Evaluation Society: Working papers, 7/2(June 2014b).
- ✓ Radej B., M. Golobič. Divided we stand: Social integration in the middle, Ljubljana: Slovenian Evaluation Society, Working Papers, 6/1(June 2013).
- ✓ Reid A. (2010). Measuring up: Evaluating the effects of innovation measures in the Structural Funds. Technopolis.
- ✓ RISS. (2011). Resolucija o raziskovalni in inovacijski strategiji Slovenije 2011–2020 (Resolution on research and innovation strategy of Slovenia). Ljubljana: Ministry for Science.
- ✓ Roumen N., S. Ilieva. (2007). Building a Research University Ecosystem: the Case of Software Engineering Education at Sofia University. Track on "Widened Software Engineering" (WISE 2007). Dubrovnik, Croatia, September 3–7.
- ✓ Schuch K. (2013). Knowledge Triangle. Centre for Social Innovation. Vienna: OEAD.
- ✓ Sjoer E., B. Nørgaard, M. Goossens. (2012). Opportunities and Challenges in the Implementation of the Knowledge Triangle. SEFI, 40th Annual Conference, Thessaloniki, 23–26 September.
- ✓ Stacey R.D. (2002). Strategic management and organisational dynamics: the challenge of complexity. 3rd ed. Harlow: Prentice Hall.
- ✓ SVREZ. (2014). Strategija pametne specializacije Republike Slovenije (Strategy of Smart Specialization for Slovenia). Ljubljana, Služba Vlade RS za razvoj in evropske zadeve.
- ✓ UNU-MERIT (2011). Innovation union scoreboard 2010. The Innovation Union›s performance scoreboard for Research and Innovation. Maastricht Economic and social Research and training centre on Innovation and Technology, Inno Metrics.
- ✓ Venn J. On the Diagrammatic and Mechanical Representation of Propositions and Reasonings. Philosophical Magazine and Journal of Science (July 1880).
- ✓ Zenker A., E. Muller (2008). European ResearchAreaandAppliedResearch:Context and Opportunities. Draft version. ■

SEA-EU-NET 2 – EU-ASEAN S&T cooperation

"SEA-EU-NET 2" is the second project that has been set up to expand scientific collaboration between Europe and Southeast Asia (SEA) in a more strategic and coherent manner. The four-year long project was launched in October 2012, involves 21 institutions from the two regions and is coordinated by the Project Management Agency at the German Aerospace Center (DLR). SEA-EU-NET 2 is deepening collaboration by:

- Continuing and intensifying the bi-regional dialogue between EU and ASEAN S&T policy makers on Senior Officials level as well as creating an annual exchange forum for researchers, innovation stakeholders, policy makers and private business to improve EU-SEA cooperation and exchange through the series of the ASEAN-EU Science, Technology and Innovation Days;
- Jointly tackling societal challenges in the fields of Health, Food Security and Safety, Metrology as well as Water Management with relevance to both regions by organising events, providing fellowships for SEA researchers and conducting studies on future collaboration potentials;
- Informing the Southeast Asian research community on the Horizon 2020 programme as well as increasing the level of Southeast Asian participation in Horizon 2020;
- Completing detailed analytical work on the current state of EU-SEA S&T relations and innovation potentials and developing recommendations on how to strengthen the relationship and feeding these into the official dialogue process; and
- Extending the dialogue on EU-SEA S&T cooperation to include a wide range of stakeholders by connecting to already existing networks and dialogues.

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Smart specialisation, the European approach to research and innovation support

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Abstract

Smart specialisation is an approach that combines enterprises, industrial, educational, research and innovation policies to identify and select a limited number of priority areas for knowledge-based investments, focusing on strengths and comparative advantages. This article provides a first set of insight and cases on the current state of the art of the process in Europe based on the experience gained on the field by the authors. Challenges for priority setting and design of policy mix are presented to the attention of policy makers and executives for further discussion.

Introduction

Smart specialisation is a place-based approach, building on the assets and resources available to regions and countries and on their specific socio-economic challenges to identify opportunities for development and growth. Smart specialisation was chosen by Europe to make the most effective use of limited public resources to promote economic development through targeted support to research and innovation (R&I). Smart Specialisation is the basis for European Structural and Investment Fund interventions as part of the current regional and cohesion policy's contribution to the Europe 2020 jobs and growth agenda. For the 2014–2020 programming period, the requirement for a national or regional R&I (strategy) (strategic policy framework(s)) for smart specialisation is an *ex ante* conditionality for the European Regional Development Fund investments in research and innovation[1].

The definition of a smart specialisation requires a vision, evidence-based competitive advantages, a limited number of strategic priorities, and the active involvement of the private sector as a base to identify and implement a well-defined set of policies to maximise the knowledge-based development potential of any region, being it strong or weak, high-tech or low-tech.

The RIS3 approach

A smart specialisation field/area is connected to effectively matching knowledge domains with market potentials. Knowledge alone does not necessarily generate economic value. On the other hand, products with little knowledge content, usually cannot defend their niches for long, if at all. Smart specialisation fields are often at the cross-section of different sectors, technologies or knowledge domains.

The selection of specialisation fields and the setting of priorities should not be a top-down action. It should be an inclusive and interactive process in which market forces and the private sector are discovering and producing information about new activities (entrepreneurial process of discovery) and the government assesses the outcomes and empowers the most capable actors for realizing this potential.

A regional strategy for smart specialisation (RIS3), should embrace a broad view of innovation, not just a technological one, from market innovation to social innovation. It should consider not only the manufacturing but also the service sector from tourism to creative industries. This is to allow each region and member state to prioritise and shape policy choices according to their unique socio-economic conditions and assets.

As far as policies are concerned, RIS3 needs to clearly outline the policy mix (EU funded and other) that will be used for its implementation; mere political visions and objectives are not enough. The outlined measures should be fit to stimulate private R&I investment. The RIS3 should also include monitoring and evaluation well as a revision mechanism for updating the strategic choices.

A RIS3 "logical intervention path"

Priority setting

A RIS3 should prioritise domains, areas and economic activities where regions or

[1] This is to ensure that funds: (1) fit into the overall research and innovation policy (as outlined in the Innovation Union flagship's "Features of well performing national and regional research and innovation systems"); (2) complement the existing national or regional funding and governance and legal measures that form part of their policy mix; and (3) support effective and efficient measures that provide incentives to private R&I investments.

countries have a competitive advantage or have the potential to generate knowledge-driven growth and ignite/sustain the economic transformations needed to tackle the major and most urgent challenges for the society (Table 1).

Priorities could be framed in terms of knowledge fields or activities (not only science-based, but also social, cultural and creative ones), sub-systems within a sector or cutting across sectors and corresponding to specific market niches, clusters, technologies, or ranges of application of technologies to specific societal and environmental challenges or health and security of citizens (e.g., ICT for active ageing, mobility solutions to reduce traffic congestion, innovative material solutions for eco-construction, etc.). Although some regions or countries may prioritize one or more key enabling technologies (KETs), others will focus on applications of such technologies to specific purposes or defined fields.

"*Most advanced regions invest in the invention of generic technologies, others invest in the co-invention of applications of the generic technology in one or several important domains of the regional economy*."

Source: Dominique FORAY

A specificity for each region

Organisational, market, service and social innovation play an important role in RIS3 as technological innovation based on scientific research. This is especially relevant for regions with comparatively weaker technological and science basis. Although a first set of priorities should be identified when the RIS3 is designed they can be changed or modified, when new information/developments make it advisable.

Priorities should be identified based on two fundamental processes:

- Focusing on market opportunities, differentiating from others, taking (and managing) risks and seeking alliances to optimise the access to and use of resources (physical, financial, intangible, such as talents, etc.).
- An objective analysis of the region/country current positioning in terms of research, innovation (including existing infrastructures), industrial structures (including clusters, position in value chains), skills and human capital (academic and other), demand (including public and societal demand), public and private budgets for research and innovation, framework conditions, and performances of the innovation eco-systems.

The entrepreneurial discovery Process

The Entrepreneurial Discovery process (EDP) is one of the 'conceptual pillars' of Smart Specialisation. This bottom-up approach is crucial to understand the main feature that distinguishes S3 approaches from innovation strategies of the past. EDP links priority-setting and the importance of market processes in producing information about the identification of the best domains for future priorities. EDP is supposed to do so in a non-prescriptive, bottom-up fashion, with no *a priori* preferential access to knowledge about future opportunities.

The EDP uses the entrepreneurial knowledge existing in a region or country and takes an entrepreneurial approach by focusing on market opportunities, differentiating from others, taking (and managing) risks and seeking alliances to optimise the access to and use of resources (physical, financial, intellectual, market knowledge, etc.). EDP should help avoiding the shortcomings of purely political interest-driven strategies, because full stakeholder involvement, through EDP, allows to draw

Table 1: A RIS3 "logical intervention path"

Regional policy objectives	RIS3 priorities	Means to be deployed	Schemes	Outputs
• Economic growth • Sustainable development • Job creation • Social inclusion	• Supporting private investment in R&D • Stimulating innovation • Enhancing SME competitiveness	• Co-investing in R&D infrastructures • Strengthening entrepreneurial approaches • Promote contaminations • Fostering international University/ SME collaborations • Transforming publicly funded knowledge into market applications • Facilitating the introduction of new products/services into the market • Encouraging the creation of new firms (spin-offs) • Promoting the scale-up of product range	• Business support "open" infrastructure • Cross-border and international actions • Financial facilities • Mentoring services • Support to commercialization of innovative products/ services • Key stakeholder matching • Competence building on entrepreneurship • Marketing of "Excellence"	• New skills • Talents attracted (back) • Start-ups/Jobs in new markets • Internationalization of existing companies • Added value jobs created • Foreign direct investment attracted

Source: Own elaboration based on Regional Policy for Smart Growth on SMEs

operational conclusions out of the results of the SWOT/statistical type of analysis to shape ownership around the strategies and to design the intervention methods according to the needs of innovation actors, in particular of course the enterprises.

The ED process in short includes:

- bottom-up process in which stakeholders from different environments (policy, business, academia, etc.) discover and produce information about potential new activities and identify opportunities that emerge through this interaction, while policymakers assess outcomes and ways to facilitate the realisation of this potential.
- integrating knowledge fragmented and distributed over many sites and organisations, companies, universities, clients and users, specialised suppliers (some of these entities being located outside of the region) by building of connections and partnerships.
- exploring and opening up of new domain of opportunities (technological and market), that are recognised as feasible and attractive.

The EDP in short

Case study: the Integrated EDP

This case by EURADA, the European Association of Regional Development Agencies, discusses on how to approach the EDP by a strong interaction between the enterprise innovation trajectory and the policy mix (Enterprise Centric Approach).

The approach postulates that: (a) any enterprise has to choose between different types, nature and ways to innovate respond to a market or a niche demand with a unique set of competitive advantages. To do that, each enterprise has to enter in a more open process to gather relevant resources (knowledge, technology, human and finance), carry out innovation and find the right route to markets; and (b) each type of innovation requires ad-hoc sets of support services (public and/or private) ranging from generic awareness raising to sophisticated financial instruments. The aim of those services is to help enterprises (SMEs) better integrate their resources in an efficient way.

Figure 1 presents the ingredients of the integrated (entrepreneurial) discovery process. The various parts of the graph have to be tailored to fit the requirements of each type or nature of innovation to be supported.

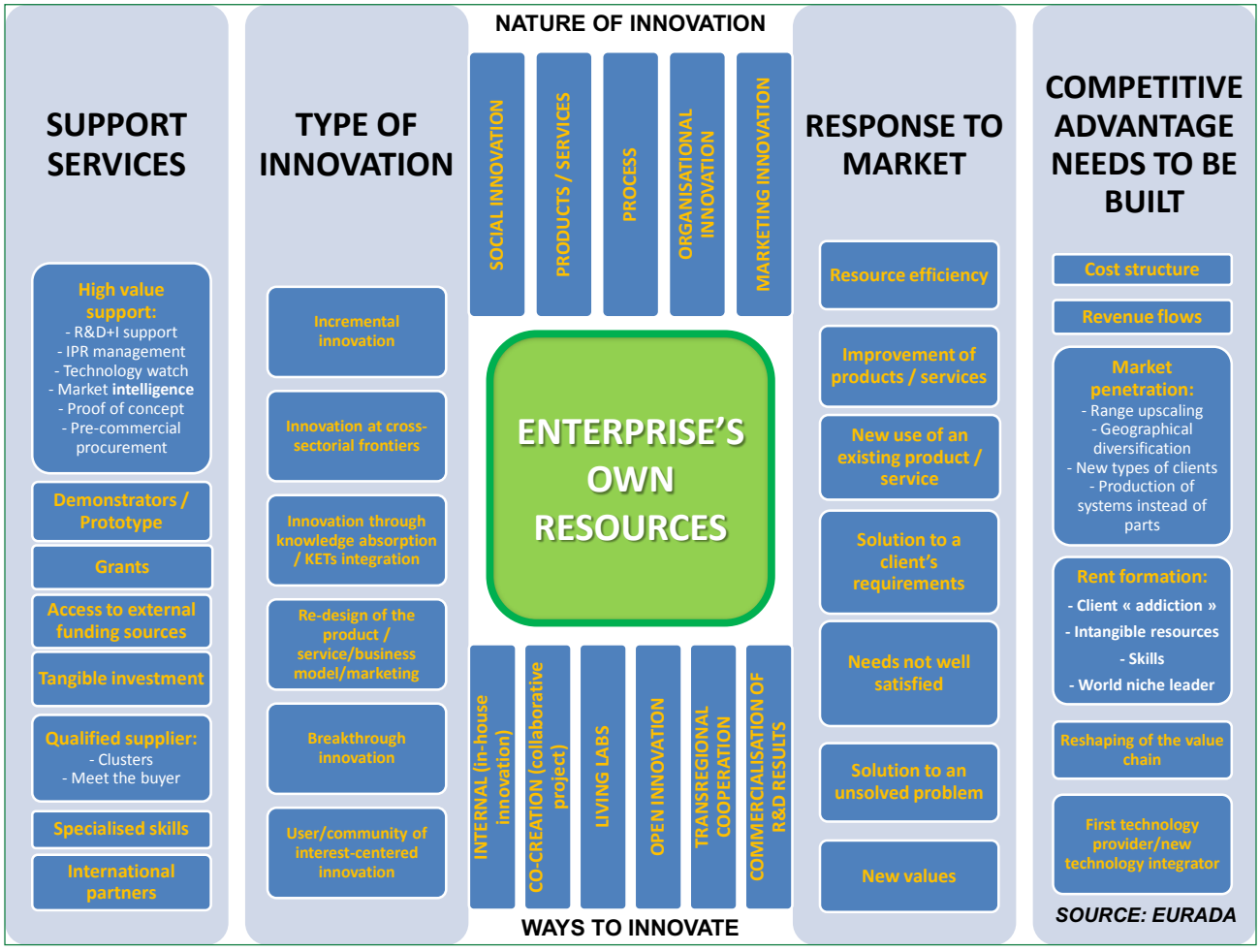


Figure 1: The integrated (entrepreneurial) discovery process

The implementation of the IDP process requires the regional stakeholders to revise their approach:

- Civil society: play their role in defining social and societal needs and contribute to the emergence of new products and services.
- Academics and researchers: understand the game of innovation and market forces and adapt their services to the expectations of enterprises including helping regional enterprises absorb new knowledge from the outside.
- Investors: contribute with new financial instruments and update their assessment grids to incorporate the risks of novel ways of innovating.
- Policy makers: review the effectiveness of the policy mix for the different innovation trajectories of regional enterprises. This can be done through interviews with different samples of enterprises clustered in accordance to the type or the nature of innovation they are investigating.

Figure 2 presents how the IDP model addresses a production process breakthrough innovation trajectory.

Policy makers have to find the right means to help the interaction between the enterprises' needs in terms of response to market and competitive advantage to be built and the support services to be supplied to enterprises. The best way to find a relevant approach which fits to enterprise needs (beneficiary-centred approach) is to involve them in the design and monitoring of the policy mix.

In parallel, the public authorities have, for each type or nature of innovation, to encourage a pipeline of projects matching their Regional Smart Specialisation Strategy (RIS3) ambitions. To do so, they can for instance undertake actions such as:

- Challenge-oriented pre-commercial procurements;
- Innovation plan competition (Hakathon);
- Foresight exercises for each type or nature of innovation;
- Brokerage of irrelevant patent of large local enterprises;

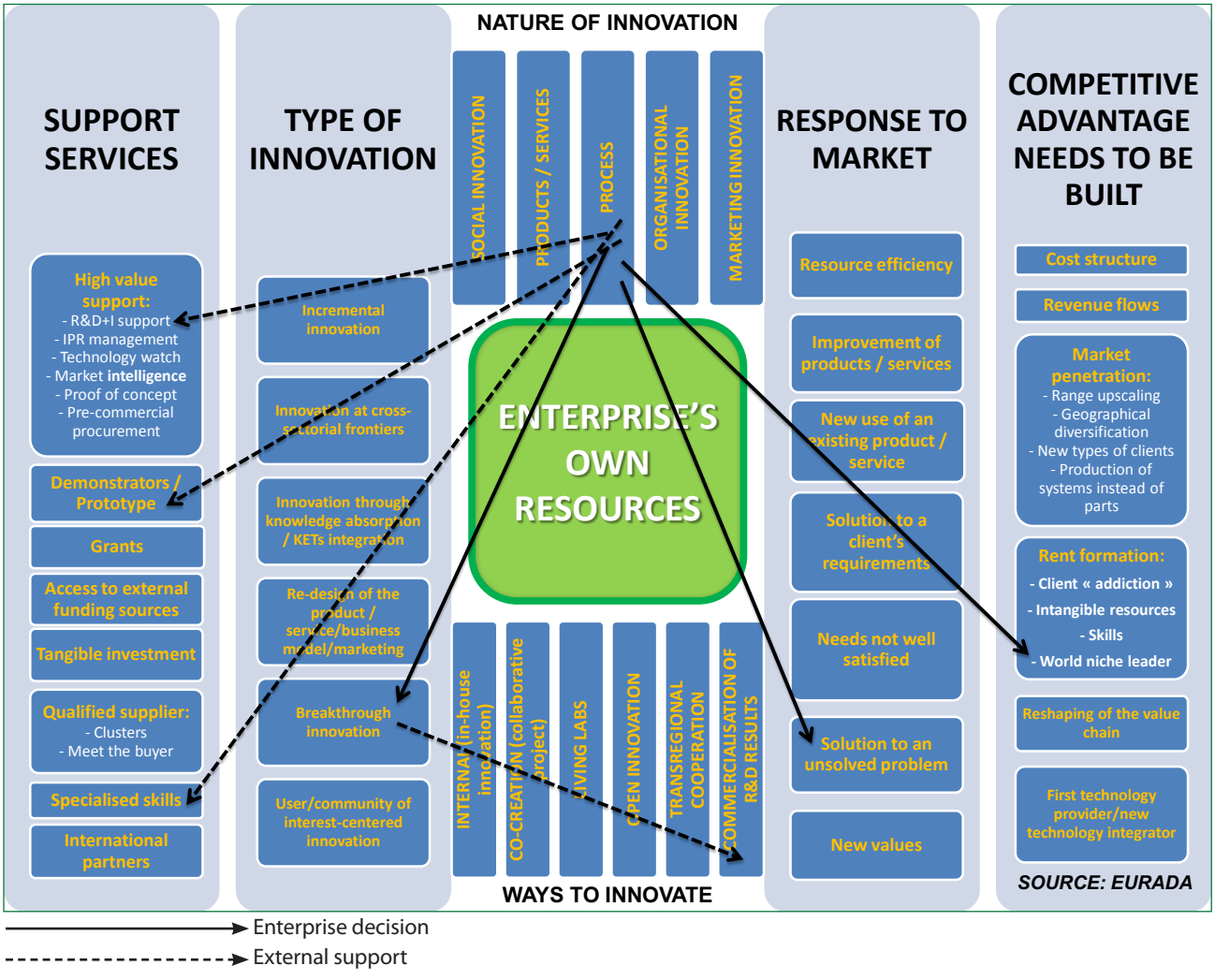


Figure 2: Production process breakthrough innovation trajectory in IDP model

- Problem solving vouchers provided to SMEs to acquire knowledge from specialised service providers;
- Co-creation labs / B2B project stimulation; and
- Defining new ways to support innovation.

Case study: RIS3 UMBRIA

Umbria is a non-S&T driven Italian region with a population growth and inflow. The regional innovation system is characterised by strengths such as a share of graduates in scientific and technological disciplines above the national average and a high level of public research technological development and innovation (RTDI) expenditure.

Main weaknesses include: a low presence of medium-sized enterprises[2], low level of private investment in R&D coupled with difficulties by SMEs to access finance for R&D, insufficient collaborations and connections between enterprises, universities and research centres, low propensity to patent, low capacity to retain talents and attract external investors, a regional R&D not characterised by strong outputs, and limited use of ICT by SMEs.

For the new 2014–2020 programming period, Umbria region has based its RTDI policy on a RIS3 focusing on R&D result exploitation rather than R&D per se. The aim is to accelerate the adoption of innovation by leveraging on the regional assets and talents, access to research results and promotion of entrepreneurship.

RIS3 Umbria identifies five main directions for change: (i) research results valorisation; (ii) innovative start-ups and knowledge intensive entrepreneurship; (iii) openness towards international markets; (iv) diversification of regional enterprises; and (v) quality of life and attractiveness of the region. RIS3 also selects green chemistry, agro-food and aerospace as areas for regional specialisation. The main novelty will be a 360° vision of innovation not only focusing on technological innovation but also broadening its scope for social, organisational, market and user driven innovation.

The planned policy interventions will promote clustering of firms to bring product to the markets while opening up to participants from outside the region and access to services, including the ones related to creativity and design. Possibility to activate demand-side initiatives (Pre-commercial Public Procurement) is envisaged for the first time in a regional policy mix defined in the RIS3. The fragmentation of the production structure, a specialisation in low and medium-low technology sectors, the weakness of endogenous R&D at international level has suggested to concentrate interventions in facilitating access to R&D results wherever they are made available and to support knowledge intensive start-up creation and demonstration activities. The need to diversify the regional economic structure moving towards more added value areas and access innovative solutions by endogenous SMEs and public institutions has led to the choice of investing the European Structural Investment Fund (ESIF) resources in company creation leveraging on the talents living in the region or willing to return back to Umbria.

Within this framework, RIS3 Umbria adopts a vision of innovation at 360°, thus including those components not strictly technological, but societal, organisational and user-oriented. The strategy operates in an open and cross-sectoral perspective, maximising complementarities and synergies between community, national and regional funds to facilitate change and better exploit intangible assets present in Umbria. RIS3 Umbria identifies, as fields where the region has achieved external recognition, green-chemistry, agro-food and aerospace. In such context, the Smart Specialisation strategy intends to give to innovation a larger role, including services to citizens and talents, to accelerate a shift towards a more intensive knowledge economy while continuing to support competitiveness of existing companies by facilitating their access to research results in an international context.

In consistency with the RIS3 the European Regional Development Fund - Regional Operational Programme (ERDF ROP) is designed to make available instruments to better utilise and adapt technologies and knowledge produced in the region and outside, as well as to attract and motivate creativity continuing, at the same time, to support research with specific attention to the relevance of intervention in relation to the characteristics of the regional production system. In addition to supporting commercial applications of R&D, innovation at 360° and knowledge-intensive company creation, the operational programme (OP) also intends to encourage the return of young entrepreneurial talents and to support the generational change, which a key ingredient to facilitate innovation processes. Such an objective will be achieved with measures incentivising business networks, clusters, spreading of a culture of entrepreneurship and innovation.

A new orientation in the innovation policy in Umbria is the focus on downstream activities in the R&D&I value chain (Box 1). The focus of the regional strategy of smart specialisation is not placed on the new knowledge (research in excellence areas) but on access to the research results (also produced elsewhere). This calls for specialisation of the intervention levers of the strategy to facilitate and/or accelerate the advantages in the region (e.g. adjustment, prototyping, proof of concept, experimentation on the market, etc.) and a selection of areas of specialisation for large scale interventions (e.g. agro-food, green chemistry, aerospace and tourism).

The Table 2 below presents the relation between the results the strategy intends to achieve, the levers to be activated to promote a change and the tools to implement. The palette for the proposed tools considers novel financial instruments (proof of concept co-investment instrument), and includes demand side approaches (pre-commercial public procurement). However, in some cases, already existing tools will follow-up with innovations concerning geographical coverage (open to participants also from other regions/countries) and beneficiaries (large industries and mid-caps).

The Co-Investment Fund, an innovative financial instrument

Common challenges for RIS3 are linked to engage private resources to how

[2] There are approximately 83,000 firms in Umbria, 28% of which are craft enterprises.

Box 1: Challanges for the future and RIS

Better cooperation and openness between the research and business systems

Umbria is not an outstanding region in terms of production of new knowledge coming from state-of-the-art research. Even though the regional context does not appear to be adequate to develop excellence in research activities, it is adequate for using results coming from research activities developed in other areas. Access to R&D exploitable results, clustering talents, SMEs and larger companies, opening up to international markets are objectives of the 2014–2020 ERDF OP.

RIS3 will support the downstream activities of research through the application of research results in trials relevant to the economic and social potential of regional and international marketing. It will also support aggregation and clustering between enterprises within and outside the region.

Diversification and change of the regional economic structure

Umbria is witnessing a decline of its competitive advantage in traditional sectors (e.g., food, fashion, mineral processing and metallurgy) leading to the need for repositioning of the regional production system.

The region will support the shift of the regional economic structure towards more added value areas by investing in knowledge intensive startups and in developing new production chains (clusters and business networks) and in projects focused on niches of greater regional competitive potential (green chemistry, agro-food, aerospace). This will also include actions to bridge the demand for innovation by enterprises (existing SMEs and startups) and public sector with knowledge providers via vouchers to access services, coaching and pre-commercial public procurement actions facilitating access to first client.

Efficient supply of innovative services to citizens and businesses

A low density of population (104.5/km^2, compared to an Italian average of 197.1/km^2) and a settlement pattern "widespread" over the region makes the provision of infrastructure and services to citizens and enterprises expensive and difficult.

The region intends to support innovation and quality of services for citizens and enterprises, promoting innovation in the public sector (regional data centre, digital proceedings, and centralised ICT pole) and offering digital services to citizens and companies. This action will be coupled with the promotion of strategic projects aimed at the regeneration of physical, social, and economic contexts of specific areas (cities and inland areas) and demand-side actions. Strategic projects will be defined using a participatory approach, based on the entrepreneurial discovery process, involving all the relevant stakeholders at the concerned territorial level.

Table 2: Umbria, relation between results, levers, actions

Expected results	Levers	Tools
• Development of a culture for research valorisation • Research downstream integration with the enterprise system	1. Use of research results obtained in the region	Proof of Concept co-investment Fund Fellowships
• Rooting of innovative sectors • Major opening towards international markets • Reinforcement of the components with a major added value	2. Use by the SMEs of the research results developed in Italy and abroad	Framework programme Incentives for prototyping Pre-competitive Public Procurement
• Increase of the entrepreneurial culture with a particular attention towards knowledge intensive sectors • Major importance of the non-traditional sectors in the regional economic system • Major attractiveness towards talents	3. Promote and support knowledge-based entrepreneurship with an orientation towards international markets	Co-investment fund in start-up, expansion phase Global grant for the promotion of the entrepreneurship. Incentives for the employment of young talents by the start-ups
• Cross-industry collaboration/contamination (related variety) • Increase of the diversification in terms of products and services • Increase of the efficiency (productivity) of the regional SMEs • Increase of competitiveness	4. Promote continuous and widespread innovation processes	Voucher for the access to services (including patenting) and tutoring (for aspiring entrepreneurs and new entrepreneurs) Incentives for networks of enterprises (open to the trans-regional and international dimension)
• Improvement of the quality of life • Increase of attractiveness of the territory	5. Develop new systems of services	Innovative public procurement Integrated strategic projects (negotiated programming)

effectively support and increase competitiveness of SMEs and leverage on endogenous knowledge and talents.

Financial instruments, and particularly public–private venture capital funds, are key policy interventions to accelerate access to markets, capitalize existing companies, and boost internationalization contributing, within a sound regional ecosystem, to regional development. Their revolving nature and capability to engage on private resources allows long-term sustainability, multiplier effect and orientation to market. In addition, especially when dealing with early stages, financial instruments such as co-investment funds, are able to bring in not only financial support but also managerial competencies, access to services and fast track to global clients.

Co-investment fund is an investment mechanism that results from a public–private partnership between the public body and business angels for investments in early stage start-ups Figure 3.

- Co-financing schemes, where private investors can participate only at the level of the fund, demonstrated to be less attractive for private investors, more interested in a direct participation in the target company through a mechanism of co-investment, as introduced by the new ERDF "off-the-shelf" regulation;
- Local Investors Networks: to maximise capabilities of sustaining the growth of target companies and attracting private investors on a deal by deal basis, as prescribed by the new off the shelf regulation, it is key that the management company has strong connections with the business angel community and more in general private investors, both at local and at national level.

What should be taken into consideration from the RIS3 experience to do things better next time?

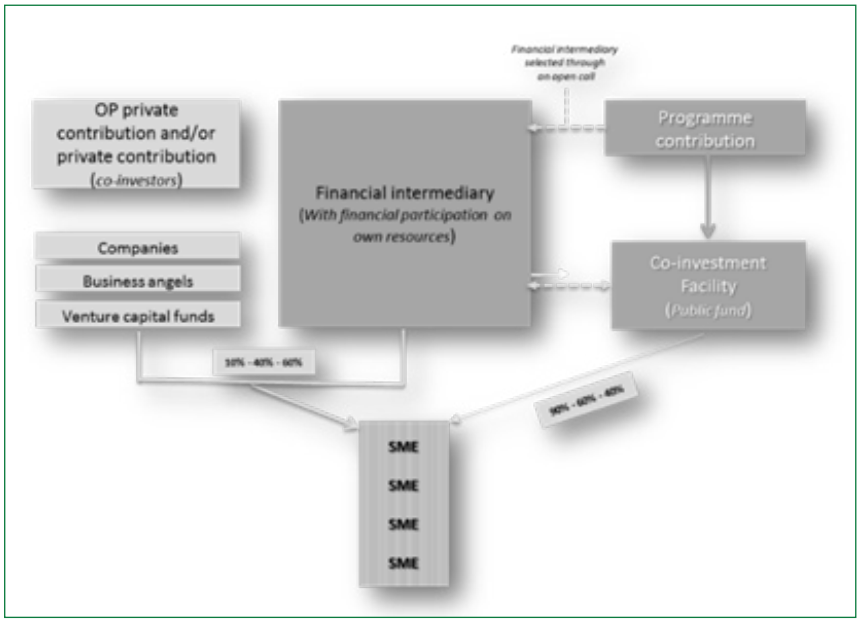
The RIS3 concept had the merit of bringing the issue of the regional R&I ecosystem under the radar of a lot of stakeholders at national and regional level. However, at the end of the day, it ended up with a more or less good strategy on paper, even if the realism of the strategy has to be put into question and if the implementation tools (policy mix or budget) are weak or look like a "business as usual" type.

Most of the RIS3 stopped their work after the first two or three steps of the process (see RIS3 Guide). As a consequence, the SWOT analysis identified the same generic priorities in most of the EU regions because they clustered priorities in a few big blocks of sectors and so lost the sense of competitive advantages at niche level. The EDP is often a policy one and not an entrepreneurial centric one.

Very few RIS3 provide figures regarding the entrepreneurial dynamics: number of start-ups created, spin-off brought to life, revenue from licensing research results, new products introduced on the market, volume of investments from business angels and VCs attracted by local enterprises, number of enterprises engaged in true internationalisation actions, etc.

Most of the RIS3 have been designed in a closed environment, i.e. without an outbound vision, without any international considerations or without true synergies with other EU policies (H2020, COSME,…). Few of them looked at the "stairway to excellence" perspective by assessing how past (ERDF) investment can contribute to support the current RIS3 priorities. In practice, the international dimension of the RIS3 is only about the support to export. No RIS3 discusses the offset of regional assets and knowledge due to global competition or breakthrough innovation as well as the lack of investment in the modernisation of the production facilities of local enterprises. Few RIS3 recognise the need of knowledge absorption by local SMEs to remain competitive.

In some cases, priorities are not in line with the findings of the SWOT analysis with the RIS3 losing its evidence base.



- Unique example of a public–private partnership involving business angels clubs, business incubators, accelerators, corporate ventures, etc.
- Investments are made on a deal-by-deal base (key to leverage at its best the contribution of the private sector);
- Co-investors are independent in their investment decisions: they are free to choose to co-invest together;
- Investments are matched on a pari-passu base;
- Funds are managed by a private management firm; and
- Due-diligence can (not mandatory) be performed jointly.

Figure 3: Key features of co-investment model

How can biotech be an asset, if there are no or very few investments by venture capitalists in the industry and no creation of spin off from the university and research centres and the region has to face a brain drain of its most talented people.

Too little attention is given to the various types of innovation. Incubators and clusters are still seen as a "safe harbour" for the creation of competitive advantages in the region without providing evidence of their past capacity to deliver high added-value support services and regional intelligence regarding new markets or new technology diffusion amongst the local SME communities.

Very few RIS3 are looking to the capacity of the eco-system to accelerate the commercialisation of research results, the creation of innovative enterprises and the absorption of those results by regional SMEs.

Most of RIS3 have few horizontal priorities which often favour cross-sector or cross-disciplinary collaborations. These types of collaborations are today one of the strongest drivers of innovation.

Not enough RIS3 are discussing the contribution of new support service tools in favour of innovation: pre-commercial procurement, KETs, robotic, 3D printing, first client search, demo centres.

References

- ✓ Guide to Research and Innovation Strategies for Smart Specialisations (RIS 3) European Union (May 2012)
- ✓ Capello, R. (2014). Smart Specialisation Strategy and the New EU Cohesion Policy Reform: Introductory Remarks; *Scienze Regionali,* Vol. 13(1), pp. 5–14.
- ✓ Foray, R. and Rainoldi, A. (2013) 'Smart specialisation programmes and implementation' S3 Policy Brief 02/2013
- ✓ R. Hausmann and D. Rodrik, "Economic Development as Self-Discovery", *Journal of Development Economics*, Vol. 72, December 2003, pp. 603-633.
- ✓ Foray, D. (2015) Smart Specialisation: Challenges and Opportunities for Regional Innovation Policies, Routledge.
- ✓ Regione Umbria – Quadro Strategico Regionale 2014-2020 (June 2014).
- ✓ Regione Umbria – Strategia Regionale di Ricerca ed Innovazione per la Specializzazione intelligente (March 2014).
- ✓ EU Commission – Regional and Urban Policy – Regional Policy for Smart Growth of SMEs (August 2013). ■

Policy Partnership on Science, Technology and Innovation

The APEC Policy Partnership on Science, Technology and Innovation (PPSTI) supports the development of science and technology cooperation and effective innovation policy in APEC economies. It serves as APEC's primary forum to engage government, private sector and academia in joint scientific research. Its strategic aim is to enhance economic growth, trade and investment opportunities, as well as social progress, in harmony with sustainability. The PSSTI will seek to develop an enabling environment for market-based innovation policy that supports commercialization, promotes innovation capacity, and facilitates cooperation among APEC members.

Among other activities, the PPSTI works to:

- Strengthen collaboration and enhance member economies innovative capacity
- Develop science, research and technology cooperation
- Build human capacity
- Support infrastructure for commercialization of ideas
- Develop innovation policy frameworks
- Foster an enabling environment for innovation.

Some highlights of selected initiatives under PPSTI include:

- White Paper on Internet of Vehicles outlining a development strategy for promoting the Internet of Vehicles (IoV) in the region;
- Initiative on Toward Innovation-Driven Development;
- 2015 ASPIRE (APEC Science Prize for Innovation, Research and Education) Prize, an annual award which recognizes young scientists who have demonstrated a commitment to excellence in scientific research;
- APEC Research and Technology (ART) Program which focuses on identifying science, technology and innovation issues and formulating policy solutions; and
- Development of Methodology and Analysis of STI Cooperation in APEC Region.

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TAKING REGIONAL INNOVATION POLICIES IN A NEW DIRECTION WITH SMART SPECIALISATION STRATEGIES

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Abstract

The concept of smart specialisation has, in a relatively short time, become a major item on the political agenda in European regional innovation policy. A core element of smart specialisation is a stronger focus on building regional growth strategies from existing capabilities and strengths while at the same time aiming for economic restructuring that benefits from smart growth. It relies on the acknowledgement that much of the regional growth strategy will be driven by entrepreneurial people, institutions and companies who need to become core players in the innovation strategy process. Although introduced in the European setting, many of the smart specialisation concepts are relevant for any region across the globe. The article describes how smart specialisation has been implemented in the European policy practice and what future challenges lay ahead.

Introduction

Smart specialisation is a relatively new concept for regional innovation policy, originating in the European Union (EU). The concept has gained momentum across Europe and a majority of regional authorities have entered the smart specialisation strategy process in the past two years. One of the main goals of this approach is a better use of public–private resources for economic renewal and innovation. Smart specialisation implies that a member State or region identifies and selects – on the basis of a bottom-up and top-down priority setting process – a limited number of priorities for knowledge-based investments focusing on regions' strengths and comparative advantages (Landabaso, 2014).

One of the rationales for introducing smart specialisation is a recurrent tendency for regions to copy innovation strategies from global frontrunners, regardless of their indigenous capabilities. Their ambition to become the next Silicon Valley led to a proliferation of "me-too" strategies, with a focus on public investments in university led typically in biotechnology, ICT and later nanotechnology. These investments pay little attention to the absorptive capacity of the region and the local skills basis to exploit these investments in terms of economic opportunities. The connection with companies and clusters in the region is often absent.

Although there are some new elements in the smart specialisation approach, the basis of the concepts is rooted in decades of knowledge and expertise on (regional) innovation policies, competitive advantage, clusters, and industry-academia linkages. However, the high level of policy attention for these regional development concepts is new. The need to develop more effective innovation policies in times of economic downturn and financial austerity has increased the urgency for smart strategies. In addition, the division between the innovation intensive regions in Europe and those regions lagging behind in investments in research, development and innovation (RD&I) seems to be widening, despite large investments by the EU from the European Structural Investment Funds (ESIF). So Europe is in clear need of a new direction for its economic development and regional innovation policy. A particular European issue is the relatively small size of most of its national markets and its administrative boundaries. This encourages a considerable duplication and fragmentation of public research and innovation investments. Thus smart specialisation is also seen as a way to pool public funds and increase the critical mass of a limited set of priorities that will receive support. Although the European Commission played a large role in disseminating the smart specialisation approach to the European regional authorities, the concept has been picked up outside Europe as well. As early as 2013 government agencies of Republic of Korea and the region of Gwangju hosted an international conference with the title "*Smart Specialisation for Innovation-Driven Growth: Its Extension to East Asia*" organised by the Organization for Economic cooperation and Development (OECD). There was a clear interest from policy makers and regional developers from several Asian countries to learn about the concept. Many elements of smart specialisation are applicable globally.

This article describes the uptake of the smart specialisation strategies across Europe and reflects on how this approach can be relevant for economic development strategies across the world. The article is based on literature and policy reports, and also on the practical experience of the Technopolis Group supporting many regions designing and implementing their regional innovation strategies.

The key concepts of smart specialisation

Practioners often complain that the mostly academic literature that introduced smart specialisation is complex and introduces ambiguous concepts that cannot be easily translated into policy practice. To summarise the key elements of the smart specialisation approach:

- A stronger focus on building regional growth strategies from existing capabilities and strengths while at the same time aiming for economic restructuring that benefits from smart growth. These are the capabilities already embedded people and organisations from the public and private sectors in the region. They form the most important links to knowledge platforms and value chains outside the region or country. This does not imply that regions should stick to mature sectors and continue what they have been doing for decades. On the contrary, it means that the focus should be on those entrepreneurial companies and organisations that could support (technological) diversification and/or establish cross-sectoral linkages to rejuvenate these sectors. The policy challenge is to identify these (potential) strengths and facilitate their further development and exploitation.
- The acknowledgement that much of the regional growth strategy will be driven by entrepreneurial people, institutions, and companies and thus that they need to be a core player in the regional strategy process. This is often referred to as the entrepreneurial discovery process. Although the smart specialisation literature often portrays this as a purely "bottom-up" process, the need for critical mass and selectivity of (public) investments requires choices where policy makers provide additional support. These strategies need to be "place-based" i.e. they need to be adapted to the local capabilities and contexts to be effective.
- Innovation policy-making is based on solid evidence and a set of competences which are more strategic and better informed, outward looking and more forward looking and "pro-active".
- The realisation that in times of economic and financial pressures governments need to prioritise and be selective in their technology and innovation support in such a way that the most "smart" growth strategies are boosted with government policies. In policy terms this means that support programmes should not only be generic and "horizontal", but emphasize and favour some specific domains or groups of firms that have the potential to drive the diversification process and innovation. The right mix should be found between generic measures that support (smart) growth and measures that focus on growth in specific domains.
- Enhanced interaction and coordination between regional, national and international policies (often dubbed as "multi-governance" policies) are needed to make a step change. More impact can be achieved if support programmes and government policies are pooled together and aligned.
- The necessity to develop strategies and capabilities in an international perspective and where possible, to utilise cross-border linkages to exploit complementary expertise and access cross-border value chains. Although not every region can harbour world-class clusters, all sectors are interconnected to international value chains. Improving the competitive position along these value chains and entering into higher value-added markets should be an important aim of any regional innovation strategy.

Smart specialisation requires the collaboration of a complex set of actors who jointly develop ideas and implement actions to arrive at new economic development directions for the region. Hoping for a single entrepreneurial actor to come up with a disruptive innovation or a completely new business model that has significant spillovers for the rest of the economy is a tactic that not many regions can afford to rely on. In practice, successful regions have facilitated the interplay between various actors to stimulate rejuvenation of economic activities. Figure 1 gives a simplified sketch of the stakeholders involved in the smart specialisation process.

Smarter policies for fitter companies

As prioritisation is at the heart of smart specialisation, the approach has been criticised by some for being a new type of top down "picking winners" method, not leaving enough room for emerging domains or companies that do not happen to be active

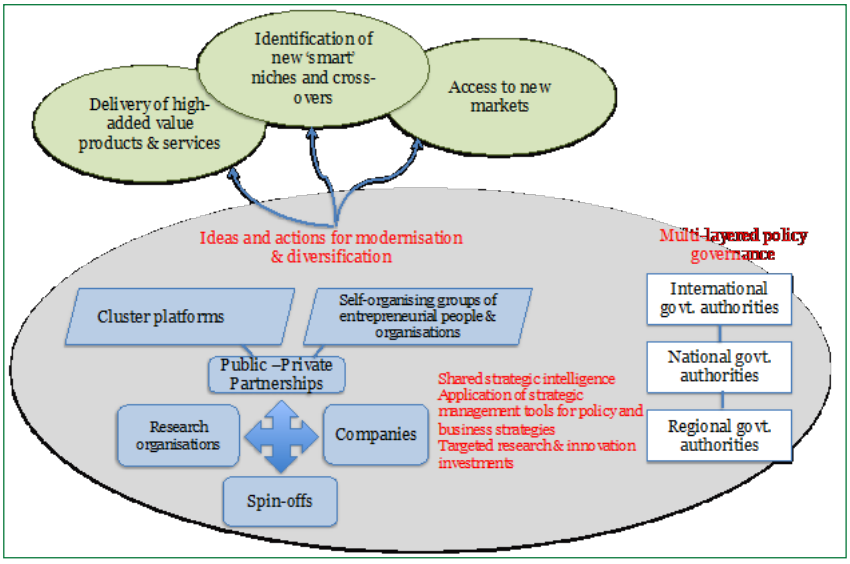

Figure 1: An overview of smart specialisation stakeholders and their interactions

in those prioritised domains. However, as aforementioned, engaging with stakeholders – representatives of companies, universities, innovation centres, etc, - in the definition of priorities is one of the key elements of the approach. However, indeed, at some point choices have to be made for technological domains, clusters or specific groups of firms that offer the best opportunities for the region to restructure and generate new growth opportunities.

As part of a wider OECD exercise to share experience on practical implications of smart specialisation a range of regions and nations from across the world conducted case studies either on policy processes in a particular region or for a thematic domain. The synthesis of these case studies revealed a number of observations (Boekholt et. al. 2013):

- There is a widespread understanding among policy makers of the bottlenecks and risks of top-down government induced specialisation. Stakeholder involvement and the combination of bottom-up and top-down prioritisation processes appear to be mainstream processes in the regions that were in the OECD study.
- The prioritisation process and making choices for a limited number of "knowledge investments" is not uncontested and still proves difficult to implement and to justify in the political arena. A lack of a coherent set of selection criteria, rivalry for prioritisation exercises by different policy authorities (e.g., ministries of science and education versus ministries for economy and industry) and political pressures from vested interests were hurdles reported in the case studies.
- The key policy instruments for smart specialisation were often already in place in the regional and national portfolio of innovation policies. The challenge is to find the appropriate policy mix that fits with the specific strategy of a region and to align that with the policy instruments available at national and international level.
- The entrepreneurial discovery process can come from many actors and requires a level of self-organisation and commitment from these stakeholders to scale this up from an individual good idea, to a novel direction that has the potential to change value chains and clusters. This asks for considerable time and resources. The challenge for policy makers is to know when and how to support these and to develop a balanced portfolio between more mature and fledgling initiatives.
- There is a role for governments to give easier access to good diagnostic and prognostic tools to assess market/technological opportunities to groups of entrepreneurial stakeholders. This could be, for instance, the facilitation of technology roadmaps or the joint access to expensive market intelligence for specific groups of companies.
- Cross-border collaboration, an essential element of the smart specialisation philosophy, is high on the policy agenda but still faces various practical bottlenecks; for instance, the fact that regional and national support programmes do not allow participation from partners outside the administrative borders. This asks for multi-level governance solutions and better coordination between different governance levels.
- Evaluation and monitoring of the overall smart specialisation strategies is still work in progress. Developing a set of indicators for monitoring and evaluation is an important task where more needs to be done in future. Nevertheless the impact of smart specialisation will take at least 5–10 years to really show results at a meso and macro level.

One of the smart specialisation case studies in the OECD study featured the petrochemical cluster in the region of Flanders (Belgium). The case study describes the transition strategy of this petro-chemical cluster towards a sustainable chemical cluster of world-class (van Til and van der Auwera, 2013). The Flemish innovation agency (IWT) provided support by means of a strategic transformation programme "Flanders Innovation hub for Sustainable Chemistry – *FISCH*". FISCH is an innovation and entrepreneurial platform for the "Flemish Chemicals using industries" which started in 2007. Although this sector had been traditionally strong (mostly based on bulk production relying on big harbour and plant infrastructures) there were signs that the cluster was losing global competitiveness. In order to strengthen the industry, FISCH took the lead in realising a transition towards sustainable chemistry that preserves the competitiveness of the chemical sector, which recognised that: (i) the business models need to be adapted to provide solutions to the sustainability needs of society, and that therefore (ii) the joint research and innovation efforts of academia, industry and society have to be increased and accelerated in targeted domains. The foreseen result is a diversification from mass production to more high complexity products that are in line with tackling the societal challenge of more sustainable production and products. The initial support from the Flemish government was to facilitate this transition process by means of joint road mapping exercises conducted by the companies involved and coordinated by the FISCH platform. This helped form a priority agenda for further public–private actions. Thus the bottom-up strategic process helped inform the policy makers what type of policy mix was needed to support this particular domain.

Thus, if Research and Innovation Strategy for Smart Specialisation (RIS3) is executed well, entrepreneurial companies and organisations will receive more "fit for purpose" policy support to help them achieve their innovation goals. Although the focus of the debate has been towards regional policy makers, for company executives it is as important to be engaged with and involved in the development of these joint public–private strategies. A review of European cases (see sections below) shows that many regional authorities are not yet experienced with this type of more interactive policy approach, where their role could be one of a facilitator of stakeholders rather than merely a "ticket window" for loans and subsidy programmes.

A pivotal role for clusters

The pivotal role of clusters in smart specialisation strategies has been highlighted

in many articles. Smart specialisation strategies integrate cluster policies into a broader transformation agenda for the entire regional economy and complement cluster policies with other cross-cutting and technology/domain specific activities (European Commission, 2013). Each cluster faces different sets of bottlenecks and needs different forms of public and private resources. The smart specialisation strategies, which are essentially place based and anticipate a direct engagement of stakeholders (as the above Flemish example illustrated), are particularly well suited to cater for the different needs of clusters. As above-mentioned, targeted policies rather than generic horizontal policies, more room for experimentation and flexibility to foster entrepreneurial approaches, are key elements of the smart specialisation philosophy. In practice, this requires quite some capabilities from all actors involved:

- Private sector partners need to be willing to organise themselves and display a level of trust to work with other public and private partners to define new roads to transition. An important role for this could be played by cluster organisations provided that they are willing to avoid a "lock-in" in their traditional sectors and are open for cross-sectoral and cross-technological opportunities.
- Universities and research institutions should become more open to perform their outreach tasks and not just in a technology push mode, but truly interactive with other public and private actors.
- Government agencies and intermediaries need to develop the capabilities to engage with the place-based policies in a more strategic manner and utilise the appropriate policy evidence to make well-founded choices in the prioritisation process. They need to actively engage with the stakeholders while at the same time not being captured by well-established interest groups. Those capacities are not always sufficiently present in public authorities. The European Commission has called for more support for policy learning and exchange of experience between practitioners from regions that have been in this RIS3 process for a long time and those that are newcomers.

The smart specialisation debate calls on (public) investments in key enabling technologies (in the literature also referred to as General Purpose Technologies) that can underpin the diversification of a range of industries and sectors and stimulate spill-overs and cross-overs between clusters. For example, in the region of South Netherlands, the RIS3 has a strong focus on stimulating cross-overs between sectors or technology domains such as applying generic ICT expertise for the logistics and food-packaging industries or combining electronics knowledge with local health care challenges. The North Netherlands has opted for a different approach using their social and health care networks to become a "living lab" where technology providers can test their new applications. Thus clusters in the smart specialisation sense are more than companies co-existing in a particular sector, but aim for particularly those actors in clusters that manage to open up new value chains and (international) market niches.

The state of play in Europe today

A corner stone of EU's so-called Cohesion Policy (aimed at decreasing the economic development gaps between EU regions) are the ESIF. This is factually a redistribution of financial resources between the developed and less developed parts of Europe. In principal each region in Europe receives these funds, but the level of funding varies with the level of development. Almost one-third of the total EU budget - € 351.8 billion - has been set-aside for Cohesion Policy for 2014–2020. A large part of these funds has to be spent on research and innovation according to implementation plans defined by the regions or their national authorities.

Political pressure within European Commission emerged to spend the huge financial resources for economic development following the smart specialisation approach. For each region (or country) developing an RIS3 became a pre-conditionality for receiving and implementing their funds for the economic development programme, which would be allocated from early 2015. The original deadline was to have a complete RIS3 submitted to the EU by the end of 2014. Hence, this explains the heightened political attention for smart specialisation strategies across Europe. The European Commission produced guidelines to support the regional authorities to help them understand the core elements of the smart specialisation concepts (European Commission, 2012).

An Expert Group formed by the European Commission recently reviewed the state of play across all EU States up to early 2015 (Clar et al. 2015). The review revealed that:

- Not all countries and regions had managed to complete a full RIS3 process in the timeframe given to end 2014, and especially most of those countries with a high dependency on ESIF funding for their total R&I investments. This demonstrated that the RIS3 process takes time and asks for sufficient human resources to be truly implemented. It also needs high-level political support. A considerable number of regions were given a relaxed deadline by the European Commission and are in the process of finalising it in 2015.
- "Openness" to other regions, countries and globally, is in general not well developed in the strategies. Overall, regions already internationally well connected, devote more attention to external co-operation in their RIS3 than regions with poor international linkages.
- Although some regions embraced a broad approach to innovation others neglected issues such as the human development and skill factors, organisational change, and regulative improvements.
- Actions to improve synergy with similar European and national initiatives and policy programmes were sparse. The multi-governance concept is not yet put into practice.
- There is a relatively strong focus on supporting the creation and de-

velopment of new knowledge and technologies and conversely a relatively weak focus on improving the absorptive capacity and the take up of existing knowledge and technologies.

- Although the expert group could not examine the evidence in detail there was a strong sense that many regions found it difficult to prioritise and continued to either provide generic support or maintained support to a broad set of the usual domains or clusters.

Of course with over 300 regions in Europe there is no "average" picture and many good examples can be found. On the topic of internationalisation, for instance, the Catalonia (Spain) RIS3 indicates that international positioning is an important consideration because the overall objective of the strategy is to "consolidate Catalonia as a European knowledge hub". The region has chosen its priority sectors also in light of their internationalisation potential. The RIS3 supports the participation of Catalonian stakeholders in inter-regional networks such as the Four Motors for Europe (with Baden-Württemberg, Germany, Lombardy, Italy and Rhône-Alpes, France) and the Pyrenees Mediterranean Euroregion. The RIS3 of Slovakia has a clear view of their specialisation of the country within the global economy. Linking multinational companies with domestic (sub)-suppliers and upgrading the competitive advantages of the latter, is an integral part of the economic development strategy.

The future of smart specialisation

It is clear that designing a smart specialisation strategy is not a one-off exercise that is finished the moment the glossy brochure is published. Smart specialisation strategies need both continuity, (a long term vision) *and* flexibility with room for experimentation and adaptation. The processes of fact-finding, stakeholder engagement and developing appropriate policy mixes need regular monitoring and possibly updating if actions prove ineffective. For those European regions that have successfully finalised their RIS3 a number of policy challenges remain.

Developing a strategy is one step. Translating a strategy into appropriate policies and implementing them effectively require even bigger steps. In the reviewed RIS3 documents, the elaboration of the implementation plans, describing the types of policy instruments and interventions that would be used to reach the targets set in the strategy, was poorly developed. This is partly due to timing: there was too little time between the RIS3 process (due for end of 2014) and the planning of the Operational Programmes, which lay down these programmes and policies (due to start in January 2015). Another explanation is that the policy makers involved in the strategy development process were not necessarily those that decide on and design the research and innovation policy programmes. The authorities and organisations responsible for strategy development seemed in many cases disconnected from the authorities that are responsible for the implementation of (EU co-funded) support programmes. A lack of high-level political commitment for the RIS3 did not ensure the connection between strategic planning and implementation. A third explanation is a lack of experience in many regions applying this different philosophy in policy making, with a larger engagement of stakeholders and policy mixes that need to be strategically aligned with the RIS3. In this context the whole smart specialisation exercise can be considered as a first step in a long process of improving public management. In addition, in many regions the degree of trust and (self-) organisation between private and public sector stakeholders is low and needs much more time and effort to flourish.

It needs to be seen whether the momentum that was created by making a RIS3 mandatory for receiving EU ESIF funds, will be maintained in the longer run, or whether regions in Europe saw this as a "ticking the formal box" exercise. Companies and other entrepreneurial actors in the regional innovation systems could play a stimulating role by taking example from the bottom-up activities that have been initiated in many regions. Hopefully, this would spur the national and regional authorities to step in as public sector partners.

Although there will always be regions not willing to embrace smart specialisation, it is more interesting to learn from those regions who have successfully applied the key concepts of smart specialisation – pro-active policies, a good mix of top-down and bottom-up prioritisation processes, active stakeholder involvement, strong interaction between the triple helix of companies, research institutions and government, lately also complemented by societal organisations, targeted research and technology investments, – long before the concept was officially introduced. The typical European examples are Baden-Württemberg, the Brainport region in South Netherlands, the Leuven region, all well endowed with high-tech industries. However, also regions originally depending on more mature industries such as Catalonia, the Basque Country and Scotland, which are increasingly diversifying their economic fabric partly as a result of long-term regional strategies. However, the time has come that the European regions learn much more from the innovation strategies applied in Asia and the Pacific, as they seem to be moving in a much faster pace, more successfully.

References

- ✓Boekholt, P., P. McCann, R. Ortega-Argilés, A. Rosiello and M. Mastroeni (2013). Lessons learned from the OECD-TIP Case Studies, in OECD, *Innovation Driven Growth in Regions: the role of smart specialisation* (OECD Publication, Paris).
- ✓Clar, G., P. Boekholt, C. Nauwelars, C. Saublens and M. Tiits (2015). Place-based Growth in a globalized Context, Perspectives for Research and Innovation Strategies for Smart Specialisation (RIS3), Expert Group report for European Commission, DG Research and Innovation (Brussels).
- ✓European Commission, Regional Policy (2012). Guide to Research and

Innovation Strategies for Smart Specialisation (RIS3) (Brussels).

✓European Commission, DG Research and Innovation (2013). The role of clusters in smart specialisation strategies (Brussels).

✓Landabaso, M. (2014). "Time for the Real Economy: the need for New Forms of Public Entrepreneurship", Scienze Regionali, *Italian Journal of Regional Science*, Vol. 13 – n. 1, 2014, pp. 127–14.

✓van Til, J. van der Auwera, C. (2013). Smart specialisation in flanders: the case of Fisch, in OECD, *Innovation Driven Growth in Regions: the role of smart specialisation* (OECD Publication, Paris).

Global Innovation Index

The Global Innovation Index 2015 (GII), in its 8th edition this year, is co-published by Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO, a specialized agency of the United Nations). Published annually since 2007, the GII is now a leading benchmarking tool for business executives, policy makers and others seeking insight into the state of innovation around the world. This year's study benefits from the experience of its Knowledge Partners: of A.T. Kearney and IMP^{3}rove – European Innovation Management Academy, the Confederation of Indian Industry and du, as well as of an Advisory Board of 15 international experts.

The core of the GII Report consists of a ranking of world economies' innovation capabilities and results. Recognizing the key role of innovation as a driver of economic growth and prosperity, and the need for a broad horizontal vision of innovation applicable to developed and emerging economies, the GII includes indicators that go beyond the traditional measures of innovation such as the level of research and development.

In just eight years, the GII has established itself as the premier reference among innovation indices, and has evolved into a valuable benchmarking tool to facilitate public-private dialogue, whereby policymakers, business leaders and other stakeholders can evaluate progress on a continual basis.

To support the global innovation debate, to guide polices and to highlight good practices, metrics are required to assess innovation and related policy performance. The Global Innovation Index (GII) creates an environment in which innovation factors are under continual evaluation, including the following features:

- 141 country profiles, including data, ranks and strengths and weaknesses on 79 indicators
- 79 data tables for indicators from over 30 international public and private sources, of which 55 are hard data, 19 composite indicators, and 5 survey questions
- A transparent and replicable computation methodology including 90% confidence interval for each index ranking (GII, output and input sub-indices) and an analysis of factors affecting year-on-year changes in rankings

The GII 2015 is calculated as the average of two sub-indices. The Innovation Input Sub-Index gauges elements of the national economy which embody innovative activities grouped in five pillars: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication. The Innovation Output Sub-Index captures actual evidence of innovation results, divided in two pillars: (6) Knowledge and technology outputs and (7) Creative outputs.

The index is submitted to an independent statistical audit by the Joint Research Centre of the European Commission. To download the full report visit: www.globalinnovationindex.org

The Confederation of Indian Industry, du and A.T. Kearney and IMP^{3}rove – European Innovation Management Academy collaborate as Knowledge Partners in 2015.

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Fax: (+41 22) - 338 81 40
Web: http://www.wipo.int

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38/F, Office Tower, Convention Plaza, 1 Harbour Road, Wanchai, Hong Kong, China
Tel: (852) 1830 668
Fax: (852) 2824 0249
E-mail: hktdc@hktdc.org

Nov 8–12
Daegu, Republic of Korea

ISES Solar World Congress 2015,
Contact: SWC 2015 Secretariat (DEXCO),
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Fax: +82-53-742-9007
E-mails: info@swc2015.org, abstract@swc2015.org
Web: http://www.swc2015.org

Nov 11–12
Yogyakarta, Indonesia

International Conference on Engineering and Technology for Sustainable Development (ICET4SD) 2015
Contact: Faculty of Industrial Technology, Universitas Islam Indonesia, Jalan Kaliurang Km. 14, 5 Yogyakarta 55584, Indonesia
Tel/Fax: +62 274-895287/+62 895007
E-mail: secretariat@icet4sd.org
Web: http://icet4sd.org

Nov 17–20
Ho Chi Minh City, Viet Nam

3rd International Conference Sustainable Agriculture, Food and Energy
Contact: Dr. Nguyen Ngoc Thuy, Nong Lam University,
Linh Trung Ward, Thu Duc Dist., Ho Chi Minh City, Viet Nam
Tel: (+84-8) 38966946
E-mail: nnthuy@hcmuaf.edu.vn
Web: http://safe2015a.safetainability.org

Nov 22–23
Colombo, Sri Lanka

Second International Conference on Environment Technology & Energy 2015 (ETE 2015)
Contact: Prabhath Patabendi, Convener ETE 2015
E-mail: ppca3000@gmail.com
Web: http://www.enviornment3000.com

Nov 24–25
Melaka, Malaysia

4th International Conference on Technology Management, Business and Entrepreneurship 2015 (ICTMBE2015)
Contact: Mrs. Salmiah binti Selamat, Conference Secretariat
Blok C, UTHM (Kampus Bandar), Jalan Cempaka 1, Taman Bunga Cempaka Biru,
86400 Parit Raja, Johor, Malaysia
Tel: +607-4531334
Fax: +607-4531650
E-mail: ictmbe2015@gmail.com
Web: http://fptp.uthm.edu.my/ICTMBE/

Dec 3–5
Dhaka, Bangladesh

SOLAR BANGLADESH 2015
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Banani Block-F, Dhaka-1213,
Bangladesh
Tel: +880 2 8812713
Fax: +880 2 9894573
E-mail: cems@cemsonline.com

Dec 3–5
Yangon, Myanmar

GREENPOWER MYANMAR 2015
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17th Floor, Plaza Permata (IGB),
6, Jalan Kampar, Off Jalan Tun Razak,
50400 Kuala Lumpur,
Malaysia
Tel: +603 03 4041 9889
Fax: +603 03 2770 5301
E-mail: info@ambexpo.com

Dec 8 – 10
Islamabad, Pakistan

Eighteenth Sustainable Development Conference (SDC)
Contact: Ms Uzma T. Haroon,
Director SDC Unit, Sustainable Development Conference Unit, Sustainable Development Policy Institute, 38 Main Embassy Road, G-6/3, Islamabad, Pakistan
Tel: (92-51) 2278134; 2278136
Fax: (92-51) 2278135
E-mail: uzma@sdpi.org
Web: http://www.sdpi.org/sdc/

2016

Jan 7–9
New Delhi, India

8th Global IP Convention
Contact: ITAG Business Solutions Ltd., Intellectual Property Consultants, Subham Plaza, Suite #1C, 1st Floor,
83/1, Dr. S. C. Banerjee Road,
Kolkata - 700 010, WB, India
Tel: +91 33 2363 3924 / 25
Fax: +91 33 2372 0635
Web: http://www.iprconference.com

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Kota Kinabalu, Malaysia

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Contact: ICGT 2016 Secretariat, International Postgraduate Network (IPN.org), Shah Alam, Selangor, Malaysia
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Web: http://icgt2016.weebly.com

Feb 19
Mumbai, India

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Contact: Ms. Mickie Gong, CBEES Senior Editor,
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Web: http://www.seta.asia

Apr 6–8
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May 24–26
Manila, Philippines

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www.binasia.net

Traditional Medicine Network
www.apctt-tm.net

Latest Innovations & News
www.techmonitor.net

Industrial promotion policies and criteria in Thailand

Thailand Board of Investment, Thailand
http://www.boi.go.th

Policies for investment promotion

In order to achieve the vision, the Board of Investment, Thailand, has set investment promotion policies as follows:

1. Promote investment that helps enhance national competitiveness by encouraging R&D, innovation, value creation in the agricultural, industrial and services sectors, SMEs, fair competition and inclusive growth.
2. Promote activities that are environment-friendly, save energy or use alternative energy to drive balanced and sustainable growth.
3. Promote clusters to create investment concentration in accordance with regional potential and strengthen value chains.
4. Promote investment in border provinces in Southern Thailand to help develop the local economy, which will support efforts to enhance security in the area.
5. Promote special economic development zones, especially in border areas, both inside and outside industrial estates, to create economic connectivity with neighbouring countries and to prepare for entry into the ASEAN Economic Community (AEC).
6. Promote Thai overseas investment to enhance the competitiveness of Thai businesses and Thailand's role in the global economy

Criteria for project approval

The Board of Investment stipulates the following criteria for project approval:

Development of competitiveness in the agricultural, industrial and services sectors

1. The value added of the project must not be < 20% of revenues, except for projects in agriculture and agricultural products, electronic products and parts, and coil centres, all of which must have value added of at least 10% of revenues.
2. Modern production processes must be used.
3. New machinery must be used. In case of imported used machinery, criteria are as follows:
   - In case of used machinery not over 5 years old, counting from the manufacturing year to the importing year, the machinery shall be allowed to be used in the project and counted as investment capital for the calculation of the cap on corporate income tax exemptions; however, they shall not be granted import duty exemption. A machinery performance certificate issued by a trusted institute identifying efficiency, environmental impact, and energy usage for the machine, as well as its fair value, must be obtained.
   - In case of used machinery over 5 years old but not exceeding 10 years old, counting from the manufacturing year to the importing year, only press machines shall be allowed to be used in the project and counted as investment capital for the calculation of the cap on corporate income tax exemptions; however, they shall not be granted import duty exemption. A machinery performance certificate issued by a trusted institute identifying efficiency, environmental impact and energy usage for the machine, as well as its fair value, must be obtained.
   - For sea and air transport activities and moulds and dies, used machinery over 10 years old, counting from the manufacturing year to the importing year, may be allowed to be used in the project as deemed appropriate, counted as investment capital for the calculation of the cap on corporate income tax exemptions and granted machinery import duty exemption.
   - Criteria shall be as specified by the Office of the Board of Investment.
4. Projects that have investment capital of 10 million baht or more (excluding cost of land and working capital) must obtain ISO 9000 or ISO 14000 certification or similar international standard certification within 2 years from the full operation start-up date, otherwise corporate income tax exemption shall be reduced by 1 year.
5. For a concession project and the privatization of a state enterprise project, the Board's criteria shall be based on the Cabinet's decisions dated May 25, 1998, and November 30, 2004, as follows:
   - An investment project of state enterprise according to the 1999 State Enterprise Corporatization Act shall not be entitled to investment promotion.
   - For Build-Transfer-Operate or Build-Operate-Transfer projects, the state agency that owns the project must

submit its project to the Board for consideration prior to any invitation to bid, and bidders shall be informed of any promotional privilege entitled to them, prior to the bidding. In principle, the Board will not promote a project where the private sector pays the state for a concession, unless such payment is deemed reasonable in comparison with what the state has invested in the project;

- For Build-Own-Operate projects, including those leased to or managed by the private sector, which in return pays rent to the state, the Board shall use normal criteria for investment promotion.
- For the privatization of state enterprises according to the 1999 State Enterprise Corporatization Act, in case of expansion after the privatization, only the expansion investment shall be eligible for promotion. Incentives shall be granted according to normal criteria for investment promotion.

Environmental protection

1. Adequate and efficient guidelines and measures to protect environmental quality and to reduce environmental impact must be installed. The Board will give special consideration to the location and pollution treatment of a project with potential environmental impact.
2. Projects or activities with type and size that are required to submit environmental impact assessment reports must comply with the related environmental laws and regulations or Cabinet resolutions.
3. Projects located in Rayong must comply with the Office of the Board of Investment Announcement No. Por 1/2554 dated May 2, 2011, on Industrial Promotion Policy in Rayong Area.

Minimum capital investment and project feasibility

1. The minimum capital investment requirement of each project is 1 million baht (excluding cost of land and working capital) unless specified otherwise on the list of activities eligible for investment promotion that is attached to this announcement. As for knowledge-based services, the minimum capital investment requirement is based on the minimum annual salaries expense specified in the list of activities eligible for investment promotion that is attached to this announcement.
2. For newly established projects, the debt-to-equity ratio must not exceed 3:1. Expansion projects shall be considered on a case-by-case basis.
3. For projects with investment value of over 750 million baht, (excluding cost of land and working capital), the project's feasibility study must be submitted with details as specified by the Board.

Market Validated Technologies Directory

The Market Validated Technologies Directory is a compendium of a tedious and comprehensive market validation exercise on selected R&D outputs from seven public universities. The universities are Universiti Sains Malaysia (USM); Universiti Malaya (UM); Universiti Kebangsaan Malaysia (UKM); Universiti Putra Malaysia (UPM); Universiti Teknologi Malaysia (UTM); Universiti Islam Antarabangsa Malaysia (UIAM) and Universiti Teknologi MARA (UiTM). The exercise started in July 2012 and completed in September 2013. It involved 358 R&D outputs with a two-fold objective: validate market for and marketability of R&D outputs before the products (R&D Outputs) are offered to industry for commercial undertakings. The Market Validation exercise came about as the result of the introduction of Market Validation Fund (MVF) under Budget 2012 initiatives. The Fund's mandate is to "ensure commercial viability of products (R&D outputs) through market validation". By definition, market validation is the process of objectively evaluating the market for an offering and understanding the target market and required features before making the investment to build it and bring it to the market. The market validation exercise undertakings involve seven steps: Selection of R&D Outputs; Technology assessment; Operational assessment; Capability assessment; Market analysis (both primary & secondary data fieldwork); Model of commercialization including financial modeling, where appropriate and Recommendation for either Market-Go/Conditional Market-Go or No Go. The Market Validated Technologies Directory provides a brief and a snapshot on what the technology is about, the potential users, market; IP status; start-up requirements; ROI/IRR and recommendation for commercialization. While every effort is made to highlight the salient information in the directory, access to a full report is required.

For more information, contact:

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Web: http:www.mtdc.com.my

Business strategy: design and implementation

Small Industries Development Bank of India (SIDBI), India
http://smallb.sidbi.in

Strategic management is critical both for starting a business, running it and for its expansion.

According to Michael E. Porter, strategy is:

- About competitive position, which refers to the firm's standing in the market relative to its competitors;
- About differentiating yourself in the eyes of the customer;
- About adding value through a mix of activities different from those used by competitors.

Overall, strategy could be termed as general plan of action which is formulated to fulfil a firm's long-term goals and objectives. Strategic Management has three components: diagnosis, design and implementation.

Diagnosis

Before designing a strategy, one should be aware/understand the elements that surround the business. Be it designing a strategy for start-up or existing business, one has to undergo an analysis of the business environment in which an enterprise operates/is going to operate. Some important tools for business diagnosis are given as follows. The tools given in the following sections can be used by the MSME manager to understand the external (PESTLE) and internal (SWOT) business environment.

Designing

Strategy formulation is the process of determining appropriate courses of action for achieving organizational objectives and thereby accomplishing organizational purpose. It is the second phase in the strategic management process that leads to the establishment of the organization's goals and of a specific strategic plan.

There are three aspects to strategy designing: (i) Corporate Strategy, (ii) Business Level Strategy, iii) Functional Level Strategy

(i) Corporate strategy

Corporate strategy is concerned with broad decisions regarding overall scope and direction of the organisation. Basically, corporate strategy pertains to determination of the growth objective and strategy for achieving it, the lines of business, and how these lines of business fit together. It is useful to think of three components of corporate level strategy:

- Growth or directional strategy — what should be the growth strategy, ranging from retrenchment through stability to varying degrees of growth — and how to accomplish it.
- Portfolio strategy — what should be the portfolio of lines of business, which implicitly requires reconsidering the degree of concentration or diversification.
- Parenting strategy — how to allocate resources and manage capabilities and activities across the portfolio — where to put special emphasis, and how much to integrate the various lines of business.

(ii) Competitive strategy (also known as business level strategy)

This involves deciding how the company will compete within each line of business (LOB) or strategic business unit (SBU). One of the most authoritative works on competitive strategy is the Porter's five forces analysis.

(iii) Functional strategy:

- Marketing strategy deals with product/service choices and features, pricing strategy, markets to be targeted, distribution, and promotion considerations.
- Financial strategy includes decisions about capital acquisition, capital allocation, dividend policy, and investment and working capital management.
- The production or operation functional strategies address choices about how and where the products or services will be manufactured or delivered, technology to be used, management of resources, plus purchasing and relationships with suppliers. For firms in high-tech industries, research and development (R&D) strategy may be so central that many of the decisions will be made at the business or even corporate level, for instance the role of technology in the company's competitive strategy, including choices between being a technology leader or follower.
- Human resources functional strategy includes many topics, typically recommended by the human resources department, but many requiring top management approval. Examples are job categories and descriptions; pay and benefits; recruiting, selection, and orientation; career development and training; evaluation and incentive systems; policies and discipline; and management/executive selection processes. (to read more, download "Human Resource Strategy" document provided at bottom of this webpage)
- IT Strategy pertains to organisation's overall objectives relating to the technology infrastructure it is going to utilise.

Preparation of technology transfer plan in Thailand

Department of Business Development, Ministry of Commerce, Thailand

http://www.dbd.go.th

It is widely accepted at present that technology is an essential element in the operation of a business and is greatly influential in the development of the competitive potential of Thai operators. However, as the success of such an undertaking is dependent on the cooperation of the transferor as well as the ability of the transferee to adapt the technology for use or to develop into a useful tool, the Foreign Business Committee has sought to rely on its powers under section 5 of the Foreign Business Act, B.E. 2542 (1999), to impose matters pertaining to technology transfer as a factor in its consideration of granting licenses for foreign business operations in Thailand. It is therefore prescribed that foreigners submitting business license applications as of 1 May B.E. 2547 (2004) must provide with their applications the details on the plans, forms and procedures for the transfer of technology in accordance with the prescribed declaration forms.

Objectives

It is widely accepted at present that technology is an essential element in the operation of a business and is greatly influential in the development of the competitive potential of Thai operators. However, as the success of such an undertaking is dependent on the cooperation of the transferor as well as the ability of the transferee to adapt the technology for use or to develop into a useful tool, the Foreign Business Committee has sought to rely on its powers under section 5 of the Foreign Business Act, B.E. 2542 (1999), to impose matters pertaining to technology transfer as a factor in its consideration of granting licenses for foreign business operations in Thailand. It is therefore prescribed that foreigners submitting business license applications as of 1 May B.E. 2547 (2004) must provide with their applications the details on the plans, forms and procedures for the transfer of technology in accordance with the prescribed declaration forms.

Preparing a technology transfer plan

The Foreign Business Committee has prescribed declaration forms in relation to technology transfer which are to be submitted with license applications. Such forms require the license applicant to provide data on plans/projects which will be undertaken subsequent to obtaining a business license. A director, manager or person responsible for the business operation of the juristic person or the foreigner who has signed the license application should also affix his/her signature on such forms. Contents under the following headings must be specified in the forms:

1. The conclusion of a technology transfer contract.
   - The contemplated contractual parties shall be specified.
   - The essence of the contract, details on the transfer or matters to be transferred shall also be specified.
2. Research and development projects. The matters to be researched and developed, the duration of programmes and the budget allocated to research and development shall be specified. The details of personnel involved in the project, i.e., details on positions, qualifications, and experience of such personnel, whether Thai or foreign, shall also be specified.
3. Training of in-house personnel. Details on training topics/programmes which are relevant to the performance of work, the length of time involved and budgetary allocations, as well as the qualifications/positions of speakers and positions of personnel expected to undergo such training, whether Thai or foreign, shall be specified. In this regard, training means a training, conference or academic seminar or workshop, special lecture, apprenticeship or activity known by other names, whether held domestically or abroad, under a project or programme and having a definite timeframe. Training should possess the objective of human development or enhancement of work performance efficiency and shall also include work visits and practical trainings.
4. The appointment of a Thai national to perform work in a position in lieu of foreigners. The position and characteristics of foreign personnel in whose place Thai nationals will be appointed as well as the period of appointment shall be specified.
5. Educational sponsorship expenses. The approximate contemplated budgetary appropriations for educational sponsorship of educational institutions on matters relating to technology shall be specified.
6. The placement of foreign experts as speakers for educating in-house personnel. Details on training programmes which include foreign experts as speakers, as well as the qualifications of the experts and participating personnel and the budget allocated for the provision of foreign experts, shall be specified.
7. The development of new products or services introduced to the market. The types and details on the products and services which will be developed and duration of introduction to the market as well as the budget involved in the operation shall be specified.
8. Other activities. In the case where an intended activity for the transfer of technology does not fall within the scope of any of the activities stated above, the applicant may specify such activities under the "other activities" heading. In all cases, if all of the contents or details cannot be contained in the forms provided, supplementary documents may be submitted.

Selected provisions of the "Philippine Technology Transfer Act of 2009"

Department of Science and Technology (DOST), The Philippines

http://www.dost.gov.ph

Article IV: Management of IPs from R&D performed by government RDIs through their own budget

Section 9. Responsibilities of RDIs Performing R&D with their Own Budget. - All government RDIs performing R&D through an annual budget provided by the government shall submit intellectual property management reports annually to the national government agencies where they are attached. The report shall contain plans for securing protection on IPs with commercial promise, the technology transfer approaches to be pursued, and the progress of ongoing commercialization of technologies derived from R&D funded from their own budget.

Section 10. Responsibilities of the Concerned National Government Agencies. - Concerned government and/or parent agencies shall monitor efforts and effectiveness of their RDIs in securing IP protection and pursuing IP commercialization, based on the annual IP management reports submitted by the RDIs.

Article V: Revenue sharing

Section 11. Revenue Sharing. - All revenues from the commercialization of IPs and IPRs from R&D funded by GFAs shall accrue to the RDI, unless there is a revenue sharing provision in the research funding agreement: Provided, That in no case will the total share of the GFAs be greater than the share of the RDI: Provided, further, That in case of joint funding, where research is funded by a GFA in part, and by other entity or entities in part, the RDI may enter into contractual agreements with the other entity or entities providing funding.

Sharing of revenues between RDI and researcher shall be governed by an employer-employee contract or other related agreements, without prejudice to the rights of researchers granted under Republic Act No. 8439 or the "Magna Carta for Scientists, Engineers, Researchers, and other S&T Personnel in the Government".

Article VI: Commercialization by the researcher and establishment of spin-off firms

Section 12. Commercialization by Researchers — In meritorious cases and to help ensure successful commercialization, an RDI shall allow its researcher-employee to commercialize or pursue commercialization of the IP and/or IPRs generated from R&D funded by the GFA by creating, owning, controlling, or managing a company or spin-off firm undertaking commercialization, or accepting employment as an officer, employee, or consultant in a spin-off firm undertaking such commercialization: Provided, that the concerned researcher-employee takes a leave of absence, whenever applicable, for a period of 1 year and renew the leave for another year, for a total period not exceeding 2 years, from the time the researcher signifies in writing that he/she desires to create or participate in a spin-off company: Provided, however, that the researcher-employee may still be allowed access to the RDIs' laboratory facilities, subject to reasonable fees and regulations which the RDIs may impose.

The leave of absence shall be included in computing the length of service for retirement but not for the commutation of leave credits earned in the public RDI. The researcher shall not earn leave credits in the public RDI during such period of leave of absence. Such leave of absence shall not likewise affect the researcher-employee's security of tenure or result in the loss of one's seniority rights.

Section 13. Detail or Secondment to the Private Sector — In case where the researcher of a public RDI would be employed by an existing company, which will pursue the commercialization, the applicable provisions of Republic Act No. 8439 or the "Magna Carta for Scientists, Engineers, Researchers and other S&T Personnel in the Government" shall prevail.

Section 14. Management of Conflict of Interest — The RDIs shall properly manage any possible conflict of interest by adopting appropriate guidelines for its researcher-employee. The guidelines for handling of such conflicts shall include, but are not limited to, the following:

(i) RDIs shall ensure that its researchers are made fully accountable for their research and that commercial objectives do not divert them from carrying out the RDI's core research program;

(ii) Heads of RDIs should ensure that where researchers have any direct or indirect financial interest in a spin-off company; they shall not act on behalf of the RDI in transactions with that company;

(iii) Where researchers of RDI are nominated as non-executive directors to the Board of a spin-off company or existing company in which the same RDI holds an equity stake, they should have a clear duty to ensure that the RDI's interests are not compromised by their role; and

(iv) RDIs should take steps to ensure that collaborative undertaking with a spin-off or existing company is governed by a formal written public agreement.

Article VII: Use by government, compulsory licensing and assumption of potential IPRs

Section 15. Use by Government or Third Person Authorized by Government and/or Compulsory Licensing — This Act shall adopt the grounds, terms and conditions for the use by government or third person authorized by government, and/or compulsory licensing as stated in the IP Code of all IPRs generated under this Act.

Section 16. Assumption of Ownership of Potential IPRs — The GFA and/or the parent agency may assume ownership of any potential IPRs in cases of national emergency or other circumstances of extreme urgency, or where the public interest requires, and in particular concerns for national security, nutrition, health, or the development of other vital sectors of the national economy, as determined by the head of the parent agency. Such determination shall be made within 30 days after the receipt of the recommendation of the Head of the GFA. Such recommendation shall be made within 30 days upon the discovery of the potential IPR by the GFA or the disclosure of the same by the RDI pursuant to Section 8(c) of this Act, or upon written notice or petition by other government agencies, or other interested persons. In cases where the parent agency itself is acting as the GFA, the Head of the parent agency may make such determination motu proprio, or upon written notice or petition by other government agencies or other interested parties. The right to the potential IPR shall be assumed by the GFA upon written order, declaration or determination by the Department Secretary or Head of the parent agency. The department or the agency that has functional jurisdiction over the technology or IPRs shall be deemed as the parent agency,

The determination by the Secretary or the Head of the parent agency of cases falling under the first paragraph of the right to the potential IPR to be vested to the GFA and/or parent agency shall be subject to the following conditions:

(a)The determination must be accompanied by an analysis and justification of such reason(s);

(b)The RDI may file with the Secretary or Head of the parent agency an opposition to such determination within 15 calendar days from notice or publication of the written determination;

(c)The assumption of the rights to the potential IPR by the GFA shall carry with it the obligation to equitably share with the RDI or other funding agencies any profits generated from the IPR; and

(d)The rights to the potential IPR shall revert to the RDI upon the cessation of the existence of the cases under this section as determined by the Secretary or Head of the parent agency motu proprio or by petition of the RDI.

Section 17. Except where otherwise provided by the IP Code, in all cases arising from the implementation of this article, no court, except the Supreme Court of the Philippines, shall issue any temporary restraining order or preliminary injunction or such other provisional remedies that will prevent its immediate execution.

Multilingual Terminology Database

The World Intellectual Property Organization (WIPO) launched a new database providing free access to a wealth of multilingual scientific and technical terminology. Through its web-based interface, WIPO Pearl promotes accurate and consistent use of terms across different languages, and makes it easier to search and share scientific and technical knowledge. The database initially includes terms found in applications filed via WIPO's Patent Cooperation Treaty (PCT) and will eventually include collections from other areas of WIPO, such as trademarks, industrial designs, and terminology found in other treaties administered by WIPO.The 90,000+ terms and 15,000 concepts in 10 languages have all been entered and validated by WIPO-PCT language experts and terminologists, who have experience working with technical documents in multiple languages. Regular additions to the data are planned.

WIPO Pearl offers powerful search features, including the ability to select source and target languages, search by subject field as well as with abbreviations, and "fuzzy," "exact" and Boolean search functions. Users can obtain a quick list of results, which can be expanded, while browsing via "concept maps" that show linkages among related concepts by language and subject field - for example, showing concepts that are broader or narrower in scope than other concepts.

For further information, please contact:

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http://www.wipo.int

Venture capital for MSMEs in India

Small Industries Development Bank of India (SIDBI), India

http://smallb.sidbi.in

Venture capital (VC) is emerging as an important source of finance for small and medium-sized firms, especially for starting the business and business expansion. An entrepreneur usually starts the business with his own funds, and those borrowed from banks. It is during expansion that they find it difficult to raise funds. SMEs have traditionally been dependent on bank finance for expansion and working capital requirements. However, in the recent past, bankers have curtailed lending to SMEs due to the greater risk of non-performing assets (NPAs) in a downturn. Thus, even though many SMEs have profitable projects and expansion plans, they find it difficult to get finance for their projects, as bankers may not be willing to fund high risk projects.

In order to provide financial support to such entrepreneurial talent and business skills, the concept of VC emerged. VC is a means of equity financing for rapidly growing private companies. Finance may be required for the start-up, expansion or purchase of a company. Venture capitalists comprise professionals in various fields. They provide funds (known as Venture Capital Fund) to these firms after carefully scrutinizing the projects. Their main aim is to earn higher returns on their investments, but their methods are different from the traditional moneylenders. They take active part in the management of the company as well as provide the expertise and qualities of a good bankers, technologists, planners and managers.

Traditionally, venture capitalists in India have shied from the Micro, Small and Medium Enterprises (MSME) sector. The non-corporate structure and small size of majority of MSMEs in India makes the venture capitalists and private equity players reluctant to investing in them due to higher transaction costs and difficulties in exits out of such investments. However, the VC scenario in India is rapidly changing. Alternative funding like VC is picking up in the India, including in the MSME sector. Moreover, the VCs are expanding their reach into areas besides the traditional VC sectors like Information Technology (IT); nowadays interest in sectors like clean energy, healthcare, pharmaceuticals, retail, media, etc. is also growing.

In recent years, the government controlled financial institutions have initiated positive and progressive measures to provide MSMEs access to funds at a reasonable and affordable costs and without any usual hurdles. VC funding institutions have been floated to induct fund at low cost, share the risk and to provide management and technology upgradation support to these enterprises. Government-funded schemes exist at both the national and the state levels. They tend to be relatively small—they typically do not exceed US$ 5 million.

The Small Industries Development Bank of India (SIDBI) is the main public financial institution involved in VC funding operations. SIDBI operates through wholly owned subsidiary, SIDBI Venture Capital Limited (SVCL). It co-finances state-level funds and sometimes co-invests with private sector VCs on a case-by-case basis.

Since 2006, some new VCs are also operating at the SME level, such as Helion Venture Partners, Erasmic Venture Fund (Accel India Venture Fund), SeedFund, and Upstream Ventures. Although technology remains the most sought after investment fields, interest has been shifting from internet companies to other types of operations—especially ICT enabled services and bio-technology.

A few VCs also operate at the early-stage, including Erasmic Venture Fund, Seed Fund, Infinity Venture, IFI sponsored facilities such as Swiss Tech VCF, and the government schemes such as SIDBI VC and Gujarat VF. Early stage VCs seek smaller deals, typically in the US$ 1–3 million range. However, they rarely go below the half million dollar mark, where there is a strong appetite for financing, but very few opportunities. Possible sources of smaller investments are represented by local public-sector facilities, business angels, business incubators funds, and isolated cases of seed VCFs, such as the microventure schemes like Aavishkaar India Micro Venture Capital Fund (AIMVCF).

Benefits of VC over other funding methods

Venture Captial has a number of advantages over other forms of finance:

- It injects long-term equity finance which provides a solid capital base for future growth.
- The venture capitalist is a business partner, sharing both the risks and rewards. Venture capitalists are rewarded by business success and the capital gain.
- The venture capitalist is able to provide practical advice and assistance to the company based on past experience with other companies which were in similar situations.
- The venture capitalist also has a network of contacts in many areas that can add value to the company, such as in recruiting key personnel, providing contacts in international markets, introductions to strategic partners, and if needed co-investments with other VC firms when additional rounds of financing are required.

Financing a start-up business: types of financial needs

Business Portal of India

http://www.archive.india.gov.in

Financial needs of a business may be classified into two on the basis of the extent of permanence:

Fixed capital

The funds required to purchase fixed or durable assets are known as fixed capital or long-term capital. The fixed or durable assets include land, buildings, machinery, equipment, furniture, etc. The nature and size of the business generally determines the amount of fixed capital needed. For instance, manufacturing activities require large investments in plant, machinery, warehouses and others, whereas trading concerns need relatively lesser investment in such assets. These assets continue to generate income and profits over an extended period of time. In addition, funds which are once invested in fixed assets cannot be withdrawn and put to some other use.

Working capital

Money invested in short-term assets or current assets is known as working capital. It includes purchase of raw materials, payment of wages and salaries, rent, fuel, electricity and water, repairs and maintenance of machinery, advertising, etc. Besides, sale of goods on credit leads to the holding of debtors balance and bills receivable, which may also be regarded as current assets. The requirement of finance for all these purposes arises at short intervals. Working capital is also known as circulating capital or revolving capital because funds invested in such assets are continuously recovered through realisation of cash and again reinvested in current assets. The amount of working capital required depends mainly on the nature of the business, the time required for completing the manufacturing process, and the terms on which materials are purchased and goods sold. For example, trading companies require more working capital than manufacturing companies.

On the basis of period of use, the financial needs of the business may be classified as follows:

Long-term capital

Long-term capital is required for a longer period, i.e., ≥5 years. The fixed assets as well as the permanent part of the working capital are financed by it.

The important sources of long-term finance are as follows:

- Issue of shares;
- Issue of debentures;
- Loans from financial institutions; and
- Reinvestment of profits.

Short-term capital

Short-term capital is required for a shorter period, i.e., <1 year. It involves financing the current assets and meeting day-to-day expenses.

The important sources of short-term finance are as follows:

- Banks
- Trade credit
- Installment credit

Medium-term capital

Medium-term capital is required for a period of 2–5 years. It involves financing certain activities like renovation of buildings, modernisation of machinery, heavy expenditure on advertising, etc.

The important sources of short-term finance are as follows:

- Issue of shares;
- Issue of debentures;
- Borrowing from banks and other financial institutions; and
- Reinvestment of profits.

The funds raised to meet both the long-term and short-term capital requirements may take the form as in what follows.

Ownership capital

It is the amount of capital invested in a business by its owners. It is on the basis of the amount invested that the owners become entitled to the profits of the business. Under sole proprietorship, the individual owner normally invests capital from his own savings. In partnership, each partner contributes capital as mutually agreed among partners. Although companies raise capital by issuing shares, the investors who contribute towards the share capital of a company become its owners by virtue of their share holdings. The rate of return on owners investment depends on the level of profits earned and is entitled to receive dividend out of these profits. Ownership capital is generally used as permanent capital or long-term capital.

Borrowed capital

The financial requirements of the business are often met by raising loans. Borrowed money involves a fixed obligation to pay interest and repay the principal amount as and when it is due. In a sole proprietary business the proprietor can borrow money on his personal security or on the security of his existing assets. A partnership firm can raise loans on the personal security of the individual partners. Companies can also borrow either by issuing debentures or bonds, or raise direct loans. Money may be borrowed for short-term and long-term, i.e., to finance fixed assets as well as current assets

Five ways to improve innovation success in India

Nielsen India

http://www.nielsen.com/in/

An analysis from Nielsen, a leading global provider of information and insights into what consumers watch and buy, shows that only 0.2% of 14,500 fast-moving consumer goods (FMCG) products launched in 2011 are considered to be breakthrough innovations.

Nielsen highlights five things that set breakthrough winners apart in India:

1. Price higher than the category average

Breakthrough innovations were priced 1.7 times higher than the average category price. Innovations focused on premium offerings are meeting the needs of many consumers who are eager to upgrade their shopping baskets.

2. Leverage the power of modern trade

Breakthrough innovations launched in 2011 sold in modern trade outlets saw value growth that was seven times more than all other innovations. Although modern trade represents only 6% of the retail landscape, it tends to attract a more affluent demographic and a more experimental shopper profile.

3. Maximize the metro opportunity

Breakthrough innovations distributed through big cities grew sales seven times faster and sold three times as much as all other innovations. Money spent in metropolitan areas account for 3 out of every 10 rupees spent on FMCG in India, and breakthrough innovations maximized reach and velocity in these top cities.

4. Focus on the north too

Although companies tend to prefer launching their innovations in the western and the southern regions of India, they also banked heavily on success in the northern region, and breakthrough innovations were delivered value growth that was four times higher than all other innovations in this region.

5. Invest well into the second year

Breakthrough innovations that focused on building demand and supporting the product in the store in 6–8 months delivered cumulative sales growth of 41%, compared with 11% for all other innovations. Breakthrough innovations were actively supported well into the second year.

Is India poised for innovation success?

Nielsen's information shows that adequately investing in the end-to-end innovation process and a strong post-launch follow through can be the difference between success and failure. A Nielsen survey of 90 innovation industry professionals from across sectors in India found that one in three (32%) Indian companies spend <5% of their revenue on research and development. One in five will launch >25% of the concepts they generate, and 53% said that conflict between short-term priorities and long-term thinking is the biggest innovation barrier. What is more, only 1 in 20 said they take feedback from retailers and partners while developing innovations, and almost half (46%) of those surveyed in the FMCG sector said they deem a launch a success or failure within 12 months of launch.

"Successful innovation is not formulaic, but there are patterns and behaviours that winners share," said Laungani, "Breakthrough innovations cut through the clutter because they address an unmet consumer need with a distinctive market-ready offering."

"India is capable of scripting many more breakthrough innovation success stories, continued Laungani. "To shift the innovation odds in its favour, companies in India should listen more acutely to partners and retailers, embrace more risk in the early stages of the innovation funnel, leverage the power of modern trade as an experimental laboratory for innovation, launch fewer innovations that are bigger and bolder and support innovations well into the second year."

Entrepreneurship Development Network Asia

The Entrepreneurship Development Network Asia (EDNA) connects leading universities in the Asian region who have the desire and capacity to develop coordinated entrepreneurship and innovation teaching, research and outreach. EDNA supports entrepreneurship education and engagement with local institutions. The goal is to ensure local institutions are networked with each other, have access to specialist resources and are able to leverage each other's strengths.

For more information, access:

http://edna.asia

The importance of innovation in entrepreneurship

SME Corporation Malaysia
http://www.smecorp.gov.my

The Malaysian economy has not only survived the global economic crises that have prevailed over the past 2 decades, but is also now going from strength to strength because the key players in our economy have been able to adapt to the challenging times and transform their businesses into innovative, competitive and resilient entities. Small businesses make up the main bulk of the Malaysian economy, and thus play a big role in the strong growth of our economy.

Although big businesses may command many of the headlines, small businesses are really the engine that drives much of our economy. The adage "small businesses are the backbone of our economy" stands true in modern-day economies. Although many small businesses may depend on outsourcing by larger companies, if they did not exist, so wouldn't the big businesses. Although small-sized businesses create more products and services, they also help circulate money in the economy quickly. They are also more enthusiastic and willing to create strong customer relationships and reliability among the employees. They work at the micro-level of economics and create a base for the macro-economic stage through the multiplier effect. They cater not only to households directly but also to aid multinationals with their products and services. Many huge clients are now turning to small enterprises to contract financially significant projects fascinated with the friendly and reliable work environment.

The growth of innovation, too, is greater in small businesses as innovation is essential to propagate the development and success of business. Entrepreneurs, as drivers of small businesses, are the innovators of the economy.

The importance of innovation in entrepreneurship can be seen in the invention of new ways to produce products or improved solutions. A service industry can expand with new or improved types of services to fulfil the ever changing needs of their clients. Manufacturers can come up with new products from raw materials and by-products.

Innovation is vital for the durability of any business. Innovation usually begins with a need. Small businesses are generally directly involved in their communities and they know exactly what the communities need and strive to come up with solutions to fulfil those needs. They seize the opportunity to innovate to ease communal problems and make lives more comfortable. Furthermore, these solutions keep getting better, easier and more useful as entrepreneurs and their small businesses come up with improved formulas and solutions. Keeping abreast with current trends and demands is an important factor for entrepreneurs to fuel their creativity and innovation. Manufacturers are constantly innovating to produce more without sacrificing quality.

Small businesses should make innovation as a fundamental part of their organisational development because innovation creates business success. Entrepreneurs must not see just one solution to a need. They should come up with ideas for multiple solutions. It is imperative for small businesses to encourage growth of innovation among their employees. By coming up with seminars and trainings to keep their employees stimulated to create something useful for others, can, in turn, result in financial gains for the company.

Competition is another factor that elevates the importance of innovation in entrepreneurship. It motivates entrepreneurs to come up with better, improved products and services than their competitors for a higher share of the market.

Innovation in entrepreneurship is without doubt a significant factor in fuelling the economy. By embracing innovation to keep up with the pace of change in the dynamic world of business, entrepreneurs are surging steadily forward with a wealth of creative and innovative ideas that transform into competitive products and services, allowing entrepreneurs and their small businesses to garner financial gains that, in turn, help boost the country's economy.

WIPO GREEN Database

WIPO GREEN consists of an online database and network that brings together a wide range of players in the green technology innovation value chain, and connects owners of new technologies with individuals or companies looking to commercialize, license or otherwise access or distribute a green technology. These technologies are available for license, collaboration, joint ventures and sale.

For more information, access:

https://webaccess.wipo.int/green/

How to become energy efficient?

Energy Efficiency Guide for Industry in Asia, GERIAP Secretariat, UNEP, Thailand
http://www.energyefficiencyasia.org

Companies can improve their energy efficiency through a six-step Cleaner Production approach.

Step 1: Planning and organization

The purpose of step 1 is to obtain top management commitment and plan and organize an energy assessment. Without an approved plan, there is no commitment!

The output of Step 1 is therefore a written proposal with selected steps and tasks to improve the company's energy efficiency that is approved by top management. An approved plan will make Steps 2–6 a lot easier!

Step 1 should take about 3–6 days. Tasks under Step 1 and the estimated time needed include:*

- Task 1a: Meeting with top management (1–2 hours)
- Task 1b: Form a Team and inform staff (0.5–1 day)
- Task 1c: Pre-assessment to collect general information (1–3 days)
- Task 1d: Select focus areas (0.5–1 day)
- Task 1e: Prepare assessment proposal for top management approval (2–3 days)

**Note*: the amount of time depends on, for example, the size of the plant, the number of people involved and the amount of information available.

How you start depends on who you are. If you are:

- **Top management** of a company interested in improving energy efficiency, then you should identify which managers and staff members are needed to get a project started, and ask them to attend a first meeting with you. You can also ask an external facilitator to attend the meeting.
- **Middle management** (e.g., Production Manager, Environment Manager) and not part of top management, then you should request top management for a meeting and invite other managers and staffs who are needed to get a project started to attend. You can also ask an external facilitator to attend the meeting.
- **An external facilitator** (e.g., Consultant, CP Centre, research institute) with an interest in getting the company to improve its energy efficiency, then you should request top management for a meeting (or ask a company manager to organize a meeting for you). You can also ask for company managers who are needed to get a project started to attend the meeting.

Step 2: Assessment

The purpose of Step 2 is to assess where energy is lost/wasted in the focus area(s).

The output of Step 2 is an overview of how much energy is lost and how much money this costs for the focus area(s). Then it becomes easier to identify options to improve energy efficiency in Step 3!

Tasks under Step 2 and the estimated minimum time needed include:*

- Task 2a: Staff meeting and training (minimum 0.5 day for staff meeting only);
- Task 2b: Prepare focus area flow charts (minimum 2 hours per focus area);
- Task 2c: Walkthrough of focus areas (depending on the focus area, but minimum 0.5 day per focus area, excluding collection of detailed data for task 2d);
- Task 2d: Quantify inputs and outputs and costs to establish a baseline (time required depends on data available as determined during the pre-assessment, task 1c);
- Task 2e: Quantify losses through a material and energy balance (0.5–1 day per focus area provided that data were collected under task 2d).

* Note: the selection of tasks, time needed and who does what should already be included in the energy assessment proposal to top management that was prepared under Task 1e.

Although Task 2b, 2d and 2e are described as separate tasks, it is possible to combine these, which will avoid repetition and save the team time!

Step 3: Identification of options

The purpose of Step 3 is to identify opportunities to improve energy efficiency for the selected focus areas.

The output is a list of options that will be investigated on their feasibility in Step 4.

Tasks under Step 3 and the estimated time needed include:*

- Task 3a: Determine causes of losses (estimated 0.5 day per focus area);
- Task 3b: Identify possible options (estimated 0.5 day per focus area);
- Task 3c: Screen options for feasibility analysis (estimated 0.5 day).

* Note: the time needed and who does what should already be included in the proposal prepared under Task 1e. Step 3 can take between 1 and 3 days depending on the number of focus areas, the number and type of losses and causes, the time available, the technical expertise of the team members and if Tasks 3a–3c are carried out separately or together. For instance, a 1-day workshop can be held where the team first looks at the causes of losses, then identifies possible options and finally screens options for feasibility analysis.

Step 4: Feasibility analysis of options

The purpose of Step 4 is to determine which options are technically, financially and environmentally feasible and in what order feasible options should be implemented.

The output of Step 4 is a proposal that is approved by top management, with recommended options for implementation and how to do this, plus a list of options that require further investigation or which are not feasible.

Tasks under Step 4 and the estimated time needed include:

- Task 4a: Technical, economic and environmental evaluation of options (time depends on the number and complexity of options investigated);*
- Task 4b: Rank feasible options for implementation (0.5–1 day);
- Task 4c: Prepare implementation and monitoring proposal for top management approval (2–3 days).

*If top management has given a maximum amount of time for the feasibility analysis, then the number and type of options selected for feasibility analysis should be adjusted accordingly.

Step 5: Implementation and monitoring of options

The purpose of Step 5 is to implement feasible options in order of priority and monitor results and discuss findings with top management.

The output of Step 5 improved energy efficiency, reduced costs and reduced GHG emissions from implemented options, and agreement with top management about the next steps.

Tasks under Step 5 include:

- Task 5a: Implement options and monitor results;*
- Task 5b: Evaluation meeting with top management (0.5 day).

*How much time this task takes depends on the number and complexity of options to be implemented. This decision will have been made when top management approved the Implementation and Monitoring Plan.

Step 6: Continuous improvement

The purpose of Step 6 is to ensure that the company continues with improving energy efficiency in a systematic way that is integrated in company processes (these are the key components of Cleaner Production).

The output of Step 6 is continuation of implementing energy efficiency options and integration of energy management into company processes.

Step 6 has only one task:

- Task 6a: Prepare a proposal to continue with energy efficiency for top management approval (2–3 days).

Home-grown innovation

A major initiative to boost the home-grown development of drugs, vaccines, diagnostics and traditional medicine in Southeast Asia is getting underway. Based on a concept developed within TDR, the Network for Drugs, Diagnostics, Vaccines and Traditional Medicines Innovation (ASEAN-NDI) brings together researchers from 10 countries of the Association of Southeast Asian Nations (ASEAN). The countries of Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (PDR), Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam are working together to create products that combat diseases common in this region of 600 million people, like tuberculosis (TB), malaria, dengue, and parasitic infections.

For more information, contact:

Bernadette Ramirez
World Health Organization
E-mail: ramirezb@who.int

Cleaner production tools

ENVIS Centre Gujarat, India
http://www.gcpcenvis.nic.in

Cleaner Production options or measures could be grouped into three major categories:

- Waste Reduction at Source;
- Recycling; and
- Product Modification.

Waste Reduction at Source options are sub-divided into "Good Housekeeping" and "Process Change" Options.

Good Housekeeping usually means changing existing practices or introducing new ways of operating and maintaining equipment. Appropriate provisions to prevent spills and to encourage good workplace attitudes are included in this category of Cleaner Production options. Good housekeeping options are normally inexpensive and their pay-back period is short. Repair leakages, close taps when not in use, raw material conveyor to reduce material handling losses, insulation of digesters, etc. Process Change includes four types of options: change in raw material, better process control, equipment modification and technology change.

Change of raw material options includes the use of less hazardous materials or raw materials of higher quality aimed at reducing the quantity/toxicity of waste generated from the process. Existing raw materials could be substituted with less polluting ones.

Substituting existing toxic dyes with non-toxic dyes to reduce effluent and product toxicity, use of H_{202} bleaching instead of chlorine-based bleaching to avoid generation of toxic absorbable organic halides (AOX).

Better process control aims at optimising the process parameters/conditions like pH, temperature, pressure, residence time, etc., to ensure operation of the existing processes at higher efficiency and with lower waste and emission generation. This may be achieved, for example, by training the operators or by adding monitoring and control devices to the machinery; e.g., optimisation of pulping process for extended cooking with NaOH.

Equipment modification includes small changes to existing equipment, such as installing drip pans, installing fluid coupling in blenders, pumps activation through level controlling mechanisms, etc., which aims at reducing the waste generation caused due to poor equipment design. This may be achieved, for example, by training the operators or by adding monitoring and control devices to the machinery.

Technology change constitutes the replacement of technology, processing sequence and/or synthesis pathway in order to minimise waste and emission generation during the production process; e.g., installation of screw press and counter current multistage vacuum washers for pulp washing.

Recycling is the on-site recovery and reuse of wasted materials and energy. The recovered materials may either be reused in the same process or used for another purpose, for example in producing useful byproducts, like creation of ligno sulphates from black liquor or lignin recovery from black liquor for use as soil conditioner.

Product Modification: Product changes involve altering the product to reduce waste during manufacture, use and disposal, i.e., during the product life cycle. These are among the more difficult waste minimisation techniques to effect. Examples include changing the composition of the product or producing a substitute by alternative product to perform the same function:

- Produce high yield varieties of paper;
- Produce unbleached paper instead of bleached paper;
- Production of paper with high ash content;
- Production of non-perfumed tissue napkins.

Global Brand Database

The Global Brand Database makes it easier to search around 11,820,000 records relating to internationally protected trademarks, appellations of origin and armorial bearings, flags and other state emblems as well as the names, abbreviations and emblems of intergovernmental organizations.The Global Brand database allows free of charge, simultaneous, brand-related searches across multiple collections.The Database page lets you easily search multiple brand-related data sources and receive instant feedback, letting you explore the brand landscape in a new and powerful way.

For more information contact:

World Intellectual Property Organization
34, chemin des Colombettes
CH-1211 Geneva 20, Switzerland
Web: http://www.wipo.int/branddb/en/

CHINA

Production of human serum albumin in cow's milk

Description

As a service unit that provides TALEN/CHRISPR and establishes animal model by fertilized egg, our project team has accumulated unequalled experience in humanization of bovine serum albumin gene and large scale production of human serum albumin in cow's milk. Dr. Qin Yangjun has independently designed and tested a number of TALEN/CRISPR carriers and carried out intracellular activity assay. He has long-term technical reserves for humanization of bovine serum albumin gene and large scale production of human serum albumin in cow's milk. Dr. Du Yubin has been engaged in gene knockout and establishment of transgenic animal models. Breaking through the conventional thinking to design the fastest and the best solution, we can get the desired transgenic animals in short time.

Areas of Application

Biological product

Advantages

Using this method, milk can be used for production of human serum albumin whereas bull serum can be used as human serum albumin extraction and cell culture. Conservatively estimated, a cow can produce 50 kg HAS , which values approximately $ 250,000. One hundred cows may produce cumulatively value of hundreds of millions of dollars.

Development Status

Laboratory model

Legal Protection

Patent

Transfer Terms

Technology licensing, Research partnerships

Contact:

Suzhou Productivity Promotion Center,
Suzhou Innovation Plaza, No.178, East Ganjiang Road,
Suzhou, China.
Tel: 0086-512-65246015
E-mail: devy_gao@joinew.com

Wireless sensor networking

Description

Our partner, a Hungarian University, has developed a new wireless mesh networking technology that is suitable for an array of applications from smart metering purposes to environmental monitoring, medical sensors, or automatization. They are interested in a sales agreement, a license agreement, or a joint venture opportunity.

HUNGARY

Background information: Wireless mesh networking solutions have many advantages in flexibility over wired solutions, but they also have different technological challenges. For example, in smart metering, most solutions use wired Power Line Communication, which needs an infrastructure and fix placement. However wireless solutions are completely mobile, can be installed freely, but their communication should be protected against interception and manipulation of transmitted data. This is an issue also in wired technologies.

Areas of Application

- Environmental monitoring;
- Medical sensors;
- Automatization; and
- Smart metering

Advantages

- At 433 MHz, the technology is available in every major trading nation of the world. At 2.4GHz ZigBee has the benefit of being available in all nations but at the cost of using a frequency that is crowded, unreliable, short-range, and has limited ability to penetrate walls, concrete and water.
- The technology is designed to provide long battery life and low device cost for bursty, asynchronous applications that require multi-year battery life. ZigBee's focus is on applications that can benefit from high data rate and shorter battery life.
- The devices are in sleep mode for most of the time and only wake as they need to transmit and receive data, and therefore battery life can be measured in years. ZigBee has no RF wake-up and uses a complex scheduling mechanism for communication and more energy to transmit at higher bandwidths.
- The technology has six times the range of ZigBee, and the ability to penetrate concrete and water as the benefits of 433 MHz.

Development Status

Commercial prototype

Legal Protection

Patent

Transfer Terms

Technology licensing, Research partnerships

Silicate-based lightweight building system

Description

Our partner, a Hungarian SME, has developed a new silicate-based lightweight building system. This innovative construction technology is the result of a long-lasting search and development meeting the requirements of the latest market trends and serves as a really simple and fast building procedure. The client is seeking for partners (governments/companies/investors) for knowhow purchase or joint ventures abroad.

Areas of Application

Our goal with our new building system is primarily to ensure an alternative technology for home builders on the already crowded world market offering tectonic materials for construction. Using the easy to install elements, such self-supporting storey and attics can be achieved which has not had any appropriate solution so far. Providing the technology and building blocks of residential buildings, we would like to create opportunity to their own investments for those who wish to build with lower incomes with their "DIY " method that proved to be very popular in the past. In compliance with the rigorous requirements we offer our fire-resistant, easy to install wall modules for industrial buildings to construct boundary and partition structures.

Advantages

- Silicate-based lightweight construction does not contain any wood or organic material.
- "Breathing", vapor pressure equalization of wall and floor structure.
- Incombustible, fire-resistant exterior components.
- Sound-bridge- and heat-free, heat-sound-proof.
- Building block surfaces are partly ready.
- Environmentally friendly building.
- Rapid on-site installation, construction time of a 100 m^2 ready-storey residential building is 10 working days.
- Also suitable for new, modern ECO residential buildings.
- Cost- and material-saving.
- Manual labor construction and does not require other lifting machinery.
- Material cost of a structurally complete, 100 m^2 residential floor areas built in m^2 approaches the cost of traditional brick buildings; however, the construction time is extremely fast on-site and so manpower labor cost is saved. Because of very good ventilation, the walls of the building dry almost immediately and thus it ensures favorable inclusion. Very low (negligible) pressure drop

Environmental Aspects
Cleaner production

Development Status
Fully commercialized

Legal Protection
Patent

Technical specifications
The main components of the technology:

- Plaster
- Gypsum fiber
- Rock wool
- Foam silicate
- Concrete When producing these building elements and construction, there is no need for greater

Transfer Terms
Joint venture, Technology licensing

For the above two offers, contact:
Laser Consult Ltd (Hungary),
H-6701 PO Box 1191, Szeged, Hungary.
Tel: +36-62/562-782
Fax: +36-62/562-783
E-mail: laserconsult@t-online.hu

Food processing equipment

Description
We are the manufacturers of food processing machinery—Grinding Mill, in which grinding media is Flour Mill Emery Stone which is exclusively manufactured by natural materials with oxychloride process. The stones are hard and have good wearing qualities, which mean less wear and thus a long life. Our flour mill machine is good for health and easier in grinding. With this particular grinding media our food machinery is better than the one made of iron grinders. Sharad Enterprises flour plant is more than just some machines. To us flour is not only a question of production, but also a question of nutrition.

Areas of Application
For grinding of Sesame (For Tahini Paste), Coffee, Spices, Pulses, Chemicals, Salt, Seeds, Wet Grinding, Chatni, Paste and all kinds of grains.

Environmental Aspects
Systems integration

Development status
Fully commercialized

Legal Protection
Trade mark

Transfer Terms
Equipment supply

Contact:
Spice Board
144 Prem Nagar Pal Road, Jodhpur 342008,
India.
Tel: 0091291 2785484
E-mail: sharadexport@gmail.com

NREP/Taste masking in drugs

Description
New Reverse Enteric Polymer (NREP) is a cationic ter–polymer which is responsive to changes in pH. It is hydrophobic and hence insoluble in water. Their main use would be for taste masking of drugs and designing custom release profiles in drug formulations.

Areas of Application

- Use as excipient
- Delivery of drugs
- Taste masking
- Coatings for moisture barrier, sustained release and rapid release
- Polymorphism inhibition Sericulture industry

Advantages

- Taste masking of solid dosage forms and liquid orals
- High Tg (121°C) – easier to process and cure
- Enhances biocompatibility
- Could be used to custom sustained release of drugs
- Avoids adverse drug–polymer interactions
- Rapid release at gastric pH
- Inhibits polymorphism in drugs
- More stable dosage forms

Development status
Laboratory model

Legal Protection
Patent

Transfer terms
Technology licensing

Technology Requests

INDIA

Micropropagation of potato cultivation

Description
We need technology for micropropagation potato cultivation.

Areas of Application
Agriculture

Studies available
Feasibility report

Project type
Start-up

Assistance sought from potential partner
Yes

Contact:
ROC
CD 149 Salt Lake, Kolkata- 700064, West Bengal,
India.
Tel: 918334006710
E-mail: pradipgamma@hotmail.com

Copper sulfate from copper scrap and waste

Description
We need consultancy for copper sulfate manufactured from copper scrap / waste / ash.

Area of Application
Many sectors including chemical industries

Project Type
Start-up

Assistance sought from potential partner
Turnkey supply of plant and machine

Contact:
Mr. J J Patel, 211, Akshat Tower, Nr Pakwan S G Highway,
Bodakdev, Ahmedabad 380054,
India.
Tel: 09904809004
E-mail: ca.jjpatel@gmail.com

Full cereal and health bar extrusion line

Description
We are a company that is looking at setting up an entire cereal flakes extrusion line. At the next stage we will be setting up the same for health bars.

Area of Application
Food processing equipment

Project Type
Start-up

Contact:
Kottaram Agro Foods
No.9 &10, 3rd Cross, Muneshwara Block, Harlugatte village,
Kudlu Gate, Bangalore 560068,
India.
Tel: 00919686202763
E-mail: support@kottaram.co.in

Disposable syringe

Description
We are interested in establishing a small plant for three part disposable plastic syringes (5 ml and 10 ml), Auto Disable Syringes. Capacity ~ 70–100 million units per annum, a mix of different sizes.

Area of Application
Manufacturing for healthcare application.

Project Type
Diversification

Assistance sought from potential partner
Turnkey supply of plant and machine

Contact:
Faith Biotech Pvt. Ltd.,
E 107, Lajpat Nagar – I, New Delhi 110024,
India.
Tel: +911141727403
E-mail: ak@faithbiotech.com

Medical disposables

Description
Medical disposables (surgical dressing)

Area of Application
Health and medical

Project Type
Expansion/Modernization

Contact:
Drug Authority
Near Mandi Samitte, Moradabad Road, Mannagar, Kanth
Moradabad 244501,
India.
Tel: 05912220061
Fax: 05912220061
E-mail: shreejeekanth@gmail.com

SME Finance Forum

The SME Finance Forum's mission is to accelerate access to finance for small and medium businesses worldwide by promoting knowledge exchange, policy change, and new connections.The SME Finance Forum is a global membership organization that works to expand access to finance for small and medium businesses. The Forum brings together financial institutions, technology companies, and development finance institutions to share knowledge, spur innovation, and promote the growth of SMEs.

For more information, access:

http://smefinanceforum.org

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