INFORMATION NOTE

Innovation and technology industry in South Korea, Israel and Belgium

1. Background

1.1 According to the World Bank, "innovation in all its forms, particularly technological innovation, has become a crucial driver of growth, enhancing competitiveness and increasing social well-being in all economies of the world."[1] As such, many countries are keen to promote their innovation and technology ("I&T") industry in order to benefit from the rise of the knowledge economy. The purpose of this information note is to provide the Panel on Commerce and Industry with information on the development of the I&T industry in South Korea, Israel and Belgium, which have achieved varying degrees of technological success in recent years.

2. Development of innovation and technology industry in South Korea, Israel and Belgium

South Korea

2.1 South Korea is lack of natural resources. To pursue economic growth, South Korea has actively developed its human capital and invested heavily in science and technology to promote I&T driven industrial development. South Korea embarked on the development of science and technology as early as in the 1960s when the country began to import and then adapt foreign technology whilst simultaneously enhancing its indigenous technological capability. The 1980s saw the change in South Korea's industrial policy from technology learning to technology development, as well as the shift in the government's role from planning and financing to promoting and facilitating private industrial research and development ("R&D").

[1] See World Bank (2010).

2.2 South Korea was severely affected by the outbreak of the Asian financial crisis in 1997. In response, the country adopted wide-ranging economic reforms featuring, among other things, targeting development of high-tech industries (particularly information technology) as a key sector for restoring the country's competitiveness. South Korea only took two years to recover and surpass the level of industrial R&D achieved prior to the crisis. More importantly, it has successfully transformed itself into one of the world's most dynamic technological economies after the crisis. In 2011, South Korea's gross expenditure on R&D ("GERD") accounted for 4.03% of its Gross Domestic Product ("GDP"), which ranked the 6th highest in the world. In addition, it ranked 18th in the Global Innovation Index 2013[2] with high ranking in the sub-indicators of (a) human capital and research and (b) infrastructure.

Israel

2.3 Israel is a small country with few natural resources. This limitation, coupled with constant threat of war by its neighbouring Arab countries, has prompted Israel to maintain technological supremacy for national survival. Israel's I&T industry underwent a breakthrough in the 1980s when the country failed to develop its Lavi jet fighter[3] due to insufficient capital, and hundreds of engineers with experience at the cutting edge of aerodynamic, avionics, computers and electronics were released into the commercial market as a result.

2.4 Israel's I&T industry continued its growth impetus in the 1990s and expanded rapidly in the 2000s. The risk-taking culture of Israel and the government's proactive measures to develop the information technology industry lent particular support. After more than three decades of development, Israel has developed itself into a world-recognized high-tech and innovation hub. Its GERD reached 4.38% in 2011, more than double the European Union ("EU") average of 2.03%. Israel also ranked 14th in the Global Innovation Index 2013, with the highest ranking in the sub-indicators of GERD and venture capital deals. In addition, Israel is second only to Silicon Valley in terms of the number of start-up companies. It is home to 4 800 start-ups and many of them are high-tech companies.

[2] The Global Innovation index is co-published by the Cornell University, INSEAD and the World Intellectual Property Organization (a specialized agency of the United Nations). The index is a composite indicator that ranks 142 economies in terms of their enabling environment to innovation and their innovation outputs.

[3] The Lavi jet fighter was planned to be the mainstay of the Israeli Air Force, and considerable export sales for the aircraft had been forecast.

Belgium

2.5 In the 1980s, Belgium successfully transferred from a unitary state to a federal country made up of the regions of Flanders, Wallonia and Brussels-Capital. A federal Belgium brought with it the transfer of the responsibility for formulating the I&T policy from the central government to the three federal regions. Such a policy change has set the stage for Belgium's technological development in the ensuing years, as each federal region can base on its socio-economic environments to formulate unique I&T policy for fostering economic growth.

2.6 At 2.04% of GDP in 2011, Belgium's gross R&D expenditure was slightly above the EU's average of 2.03%. Nevertheless, it ranked 21st in the Global Innovation Index 2013 with high ranking in the sub-indicators of knowledge adsorption and education. In addition, the business sector has played an important role in I&T development which accounted for about 60% of GERD in 2011.

3. Salient features of innovation and technology industry in South Korea, Israel and Belgium

3.1 Based on the **Table** on pages 6–12, the salient features of the I&T industry in South Korea, Israel and Belgium are summarized below for members' reference.

South Korea

3.2 South Korea has enacted a specific Act – the *Framework Act on Science and Technology* – governing the development of the I&T industry currently overseen by (a) the Ministry of Science, ICT and Future Planning and (b) the National Science and Technology Council. In particular, the *Act* requires the South Korean government to formulate a basic plan for the science and technology sector every five years. The latest basic plan was released in July 2013, targeting to make use of the government's support for domestic R&D projects to raise South Korea's innovation capacity, create 640 000 new jobs and increase the contribution of basic science research to the GDP growth over the next five years.

3.3 The business sector has played a dominant role in the development of I&T in South Korea, accounting for 75% of GERD in 2011. The dominance of the business sector is mainly attributable to the chaebol system[4] built around the government's favorable policy towards business conglomerates.

3.4 South Korea has made well use of its well-established infrastructure, highly educated labour force and strong government's support to develop competitive edge in a number of high-tech industries. These include the information communication technology, liquid crystal display, semiconductor and medical/biotechnology industries. However, factors such as the crowding out of small and medium enterprises ("SMEs") by chaebols, insufficient basic science research, and weak link between the technology development and application, may overshadow South Korea's future technological development.

Israel

3.5 Israel has enacted a specific legislation – the *Encouragement of Industrial Research and Development Law* – governing the development of its I&T industry. In particular, the legislation established the Office of the Chief Scientist under the Ministry of Industry, Trade and Labor to task with the implementation of the government's policies on supporting and encouraging industrial R&D.

3.6 Israel's venture capital and incubator programmes have played an important role in the booming high-tech sector, which is concentrated in an area nicknamed "Silicon Wadi [5]". The area is considered second in importance only to its Californian counterpart, the Silicon Valley. The local Israeli venture capital industry was born as early as in 1985 with the establishment of a United States-Israeli venture fund. Israel had approximately 70 active venture capital funds in 2012, of which 14 were international funds with offices in Israel. Meanwhile, the Office of the Chief Scientist runs incubator programmes under which novice companies with innovative concepts but lack financial means to develop their business can apply for funding from the programmes.

[4] Chaebol is South Korea's large family-owned conglomerate, usually organized in the way of holding company to control various legally independent firms of diversified business.

[5] Silicon Wadi is an area with a high concentration of high-tech industries in the coastal plain in Israel.

3.7 Israel has achieved progress on a number of technological areas including water technology, space technology, and biotechnology and nanotechnology industries. The comparative advantages of Israel include: (a) a pool of talented scientists, researchers and engineers, (b) ease of entrepreneurship under the venture capital and incubator programmes, and (c) technological diffusion between the defence and civil sectors. Challenges of the country mainly come from insufficient business management experience of start-up companies, and the stagnated budget for universities and the resultant decline in available funding for research.

Belgium

3.8 Unlike South Korea and Israel, Belgium does not set out any specific legislation to promote the development of the I&T industry. Each region develops its own strategy to foster research and innovation, but they must comply with the requirement of allocating 3% of their GDP to R&D projects as set out in Europe 2020.[6]

3.9 Both the government and business sectors are actively involved in the development of the I&T industry in Belgium. The federal government provides tax incentives for eligible R&D projects, and private companies within the same industry form collective research centres to conduct technological research for the whole industry. In addition, venture capital is also available in the public and private sectors for innovative start-up companies.

3.10 Belgium has developed its competitive edge in a number of industries, such as diamonds, pharmaceuticals, biotechnology and renewable energy. These industries thrive on factors such as the government's support measures, quality workforce, presence of business clusters and easy access to start-up capital. Nevertheless, Belgium is faced with challenges such as the government's budget constraint for research initiatives, dominance of SMEs with low absorptive capacity for new technology, and human resource constraints.

[6] In 2010, the EU launched a long term growth strategy – Europe 2020 – to turn itself into a smart, sustainable and inclusive economy delivering high levels of employment, productivity and social cohesion. Europe 2020 sets outs five key targets to be achieved by 2020, which includes a target investment of 3% of EU's GDP in R&D projects.

Table — Innovation and technology industry in South Korea, Israel and Belgium

South Korea	Israel	Belgium
(a) Responsible government authorities		
• The Ministry of Science, ICT and Future Planning encourages start-up companies by fostering an environment where their creative ideas and innovative technologies can be used for new value-added industries, new jobs and new growth engines that are necessary for South Korea's sustainable growth. • The Presidential Advisory Council on Science and Technology advises the President on the I&T policy and development in South Korea. • The National Science and Technology Council co-ordinates major I&T policies and projects, develops strategic policies on technological innovation and provides guidelines for future development of the I&T industry.	• The Ministry of Industry, Trade and Labor establishes (a) the Office of the Chief Scientist to implement the government's policy on supporting and encouraging industrial R&D, and (b) the Investment Promotion Centre to promote foreign and local investment in domestic I&T industry. • The Ministry of Science, Technology and Space identifies the research areas in I&T that are of national priority, and develops human capital through investing in higher education and science and technology.	• The responsible federal authorities include: (a) the Inter-Ministerial Conference on Science Policy which co-ordinates policy matters at the federal, regional and community levels; and (b) the Federal Science Policy Office which co-ordinates science policy at the federal level and international co-operation programmes on behalf of the Belgian authorities. • There are also a number of government authorities establishing at the regional and community levels for overseeing the development of local I&T industry.

Table — Innovation and technology industry in South Korea, Israel and Belgium (cont'd)

South Korea	Israel	Belgium
(b) Specific legal provisions governing the industry's development		
• As stipulated under Article 127(1) of the *Constitution*, "[t]he State shall strive to develop the national economy by developing science and technology, information and human resources and encouraging innovation." • The *Framework Act on Science and Technology* also provides an institutional strategy that can (a) comprehensively and systematically promote the science and technology policy to cope with the knowledge- and information-oriented society of the 21st century and support the innovation-led economic system, (b) set out the medium- and long-term development goals in science and technology on the basis of the *Act*, and (c) establish the basic plan for science and technology.	• The *Encouragement of Industrial Research and Development Law* governs the support and incentive programmes run by the Office of the Chief Scientist. The purpose of the *Law* is to encourage Israeli companies to invest in R&D projects with the government sharing the risk inherent in such projects. • The *Law* also specifically states that the intellectual property developed under the government-funded programmes can only be transferred abroad with approval from the Office of the Chief Scientist.	• No specific legislation enacted for the development of the I&T industry.

Table — Innovation and technology industry in South Korea, Israel and Belgium (cont'd)

South Korea	Israel	Belgium
(c) Government policies to promote the industry		
• As stipulated under Article 7 of the *Framework Act on Science and Technology*, the South Korean government shall establish mid- and long-term policy objectives and directions on I&T development, and based thereon, formulate the basic plan for the I&T industry every five years and execute it. • The latest basic plan, entitled the 3rd Science and Technology Basic Plan, was released in July 2013. The objectives of the plan include: (a) raising South Korea's innovation capacity; (b) increasing the R&D funding by 35% to 92.4 trillion won (HK$671.6 billion) between 2013 and 2017; (c) creating 640 000 new jobs; and (d) increasing the contribution of basic science research to the GDP growth.	• There is no national plan for the development of the I&T industry in Israel. Nevertheless, several government reports and policy documents provide orientations. For example, certain industries have been identified for policy attention, including biotechnology, nanotechnology and clean technology. Attention is also paid to improving the performance of low-technology industries and the quality of human capital.	• Europe 2020 requires all Belgian authorities to achieve the goal of allocating 3% of GDP to R&D projects. • Belgium does not have a national strategy. Each of the three federal regions sets out its own development plan, namely: (a) the Flanders in Action for the Flemish Region to lay out a blueprint of transforming Flanders into multi-disciplinary innovation hubs in areas such as green energy, green logistics and eco-innovation; (b) the Marshall Plan 2.Green for the Walloon Region to strengthen science research as an engine of future development with specific measures taken to pursue this priority (such as implementation of joint research strategy with Brussels-Capital in strategic themes); and (c) the Regional Innovation Plan for the Brussels-Capital Region to set out a number of short term actions and long term directions to be taken for 2013-2014 and 2014-2020 respectively to enhance the innovation capacity of Brussels-Capital.

Table — Innovation and technology industry in South Korea, Israel and Belgium (cont'd)

South Korea	Israel	Belgium
(d) Public and private participation in the industry		
• Private sector is the major driver of South Korea's I&T industry which contributed 75% of GERD in 2011. • Chaebols play a dominant role in the I&T industry, while SMEs only have minimal influence in the industry. The dominance of chaebol system is attributable to the government's favourable policy towards business conglomerates. • The largest chaebols in South Korea's I&T industry are Samsung, Hyundai and LG.	• The Israeli government has developed various R&D incentive programmes targeting at industries at different stages of development and in different areas of technological innovation. Of particular importance is the Technological Incubators programme run by the Office of Chief Scientist. • The Technological Incubators programme enables novice companies with innovative concepts but lack capital to develop their own business to apply for funding from the Office of Chief Scientist and translate their concepts into commercial products. • The private sector has also played an important role in the development of the I&T industry in Israel, as evidenced by the strong presence of venture capital in Israel. Israel had approximately 70 active venture capital funds in 2012, of which 14 were international funds with offices in Israel.	• Public funding for R&D is available at the federal, regional and community levels. A number of business angels also exist in Belgium to provide a complementary source of finance to innovative small businesses. Business angels are individual investors, usually with business experience, who provide capital for start-up firms. • Private companies within the same industry set up collective research centres to conduct technological research for the whole industry and support technology transfer among the companies. The collective research centres obtain research funding from the participating private companies. • The public and private sectors also work together in the development of the I&T industry in Belgium. For example, the regional government in the Walloon Region funds research projects collaborated between research institutions in the universities and private companies.

Table — Innovation and technology industry in South Korea, Israel and Belgium (cont'd)

South Korea	Israel	Belgium
(e) Major innovation and technology industries		
Information Communication Technology ("ICT") • South Korea topped the International Telecommunication Union's ICT Index(1) ranking for three consecutive years. Liquid crystal display ("LCD") • South Korea is home to two of the largest LCD manufacturers in the world, namely Samsung and LG. Semiconductor • South Korea is a global market leader, ranked 4th in the world's semiconductor market in 2012. Medical/biotechnology industry • The industry is selected by the government as a new growth engine in South Korea under the growing demand for personalized medicine and regenerative medicine of the ageing society.	Water technology • To tackle the water scarcity problem, Israel has encouraged innovation in water-related technologies including drip irrigation, seawater desalination, and large-scale filtration of lake water. Space technology • The Israel Space Agency has had a long history of satellite programmes for both reconnaissance and commercial purposes. Biotechnology and nanotechnology industries • A number of life sciences and medical companies have set up their research institutions in Israel.	Diamond industry • Antwerp of Belgium is the world's largest diamond trading hub. Pharmaceutical industry • Belgium is a world leader in the pharmaceutical industry with a number of pharmaceutical companies engaged in drug discovery. Biotechnology • The Belgian biotechnology sector is divided into three areas: healthcare, industrial and agricultural biotechnology. Renewable energy • The Belgian companies have developed in-depth expertise in the fields of biomass, wind, wave and tidal, photovoltaic and solar thermal energy.

Note: (1) The International Telecommunication Union's ICT Index ranks 157 countries according to their level of ICT access, use and skills.

Table — Innovation and technology industry in South Korea, Israel and Belgium (cont'd)

South Korea	Israel	Belgium
(f) Comparative advantages in developing the industry		
• Well-established infrastructure with high broadband and wireless network penetration. • Abundant pool of highly educated workers and researchers to meet increasing demand for R&D after years of the government's investment in education. • Strong government commitment to establish a technology-based nation through support measures such as tax incentives and financial assistance. • Presence of local companies that command a large share of the global market (e.g. Samsung, Hyundai and LG).	• Conducive environment for entrepreneurship as Israel has the highest level of venture capital per GDP among the developed countries. Also lending support is the government's support programmes to help early-stage technological entrepreneurship to turn innovative ideas into potentially commercial products. • Being among the developed countries with the highest level of adult population at tertiary education. In addition, Israel has the greatest number of scientist/engineer per capita in the world. • An immigrant and multicultural nation encouraging international co-operation and free flow of talents and innovative ideas into Israel for technological advancement. • Technological diffusion between the defence and civil sectors with the spin-off of defence technology for commercial applications. • Presence of a number of multinational high-tech companies to take advantage of R&D facilities and pool of talented researchers in Israel.	• A country with a sizable tertiary educated population and the third largest inflow of doctoral students within the EU. • Presence of business clusters which involve the participation and co-operation of universities, research institutions and companies active in the industry to increase the productivity with which the participating companies can compete on a national and global scale. • Government support measures through formulating region-based I&T policy and operating various tax incentive schemes to attract R&D investment and researchers to stay in the country. • Existence of various venture capital funds and business angels to invest in innovative start-ups.

Table — Innovation and technology industry in South Korea, Israel and Belgium (cont'd)

South Korea	Israel	Belgium
(g) Major challenges to the industry		
• Chaebols in Korea create obstacles for SMEs to start up and survive. Chaebol culture also discourages risk-taking and creativity, and its non-transparent management style hinders knowledge transfer and international collaboration. • The R&D efforts in South Korea have been devoted mainly to technology development, while basic science research has been more or less neglected. The weakness in basic science research may pose a fundamental problem for the I&T industry. • R&D results have not been linked effectively from universities and research institutions to industrial uses.	• Insufficient experience in business management has enticed many local start-ups to sell their potentially success business pre-maturely to venture capital funds. This hinders the expansion of start-ups into large enterprises. • University funding essentially has stagnated in recent years, resulting in a decline in available funding for research and deterioration of teaching and research infrastructure.	• Public R&D expenditure is comparatively low and this trend is unlikely to change in the short term due to the government's budget constraint. • A large number of companies in Belgium are SMEs with a limited budget for R&D investment and low absorptive capacity for new technology. • Human resource constraints (e.g. low number of science and technology graduates) may hinder the development of the I&T industry.

References

South Korea

1. Center for Technology Innovation of Brookings Institution. (2012) *Building an IT Economy: South Korean Science and Technology Policy*. Available from: http://www.brookings.edu/~/media/research/files/papers/2012/9/12%20korean%20technology%20campbell/cti_19%20_korea_tech_paper_formatted.pdf [Accessed December 2013].

2. Chung, S.C. (2011) *Innovation, Competitiveness and Growth: Korea Experiences.* Available from: http://www.rrojasdatabank.info/wbdevecon10-22.pdf [Accessed December 2013].

3. *Framework Act on Science and Technology*. Available from: http://english.msip.go.kr/english/brd/m_83/down.do?brd_id=eng_g0102&seq=27&data_tp=A&file_seq=1. [Accessed December 2013].

4. Institute for Defense Analyses. (2013) *Innovation Policies of South Korea*. Available from: https://www.ida.org/upload/stpi/pdfs/d4984final.pdf [Accessed December 2013].

5. Invest Korea. (2013) *Industries.* Available from: http://www.investkorea.org/ikwork/iko/eng/cont/contents.jsp?code=10202 [Accessed December 2013].

6. Ministry of Strategy and Finance, Republic of Korea. (2013) *2012 Modularization of Korea's Development Experience: The Internalization of Science and Technology in the earlier stage of Economic Development in South Korea.* Available from: https://www.kdevelopedia.org/mnt/idas/asset/2013/06/17/DOC/PDF/04201306170126736076481.pdf [Accessed December 2013].

7. Organization for Economic Co-operation and Development. (2009) *OECD Reviews of Innovation Policy: Korea*. Available from: http://browse.oecdbookshop.org/oecd/pdfs/product/9209041e.pdf [Accessed December 2013].

Israel

8. *Encouragement of Industrial Research and Development Law 5744-1984*. Available from: http://www.moital.gov.il/CmsTamat/PrintVersion.aspx?guid={9F263279-B1F7-4E42-828A-4B84160F7684} [Accessed December 2013].

9. Made in Israel. (2013) *Innovation Nation*. Available from: http://www.madein-israel.com/selectedArticle.aspx?articleId=16&name=INNOVATION-NATION [Accessed December 2013].

10. Ministry of Economy. (2013) *The OCS – Policies and Programs*. Available from: http://www.moital.gov.il/NR/exeres/A1541A69-E947-4FAF-8577-76864F59CD1F.htm [Accessed December 2013].

11. Ministry of Industry Trade and Labor. (2013a) *Business Climate: Venture Capital in Israel*. Available from: http://www.investinisrael.gov.il/CmsTamat/InvestInIsrael/Inv_PrintVersion.aspx?guid={A19A138D-87A7-416B-8D62-1C968E035E13} [Accessed December 2013].

12. Ministry of Industry, Trade and Labor. (2013b) *Government-Supported Incentive Programs.* Available from: http://www.moital.gov.il/NR/rdonlyres/83C79A59-DCCE-4950-8257-DE48B9D0B9DC/0/IncentivePrograms.pdf [Accessed December 2013].

13. Ministry of Industry, Trade and Labor. (2013c) *R&D Incentive Programs*. Available from: http://www.moital.gov.il/NR/rdonlyres/5E7A4322-4D0F-4320-953C-83F94024E7AA/0/RDspreads.pdf [Accessed December 2013].

14. Organization for Economic Co-operation and Development. (2011a) *OECD Environmental Performance Reviews: Israel*. Available from: http://browse.oecdbookshop.org/oecd/pdfs/product/9711111e.pdf [Accessed December 2013].

15. Organization for Economic Co-operation and Development. (2011b) *Policies to Support Eco-innovation in Israel*. Available from: http://www.oecd.org/israel/48354947.pdf [Accessed December 2013].

Belgium

16. *Belgian Science Policy Office*. (2013) Available from: http://www.belspo.be/ [Accessed December 2013].

17. Erawatch – Platform on research and innovation policies and systems. (2013) *Country pages: Belgium*. Available from: http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/be/country [Accessed December 2013].

18. European Commission. (2013) *Research and innovation performance in Belgium*. Available from: http://ec.europa.eu/research/innovation-union/pdf/state-of-the-union/2012/countries/belgium_2013.pdf [Accessed December 2013].

19. *Flanders in Action*. (2013) Available from: http://www.vlaandereninactie.be/en [Accessed December 2013].

20. Innovative Brussels. (2013) *Update of the Regional Plan for Innovative of the Brussels-Capital Region*. Available from: http://www.innovativebrussels.irisnet.be/en/documents/mise-a-jour-du-pri-en/ [Accessed December 2013].

21. Invest in Belgium. (2013) *Important industries and innovative companies*. Available from: http://ib.fgov.be/en/important_industries/ [Accessed December 2013].

22. Invest in Wallonia. (2013) *The Marshall Plan 2.Green for Wallonia's economy*. Available from: http://www.investinwallonia.be/why-wallonia/economie-et-plan-marshall/?lang=en/ [Accessed December 2013].

Others

23. *Global Innovation Index*. (2013). Available from: http://www.globalinnovationindex.org/ [Accessed December 2013].

24. *International Monetary Fund*. (2013). Available from: http://www.imf.org/ [Accessed December 2013].

25. Organization for Economic Co-operation and Development. (2012) *OECD Science, Technology and Industry Outlook 2012*. Available from: http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-outlook-2012_sti_outlook-2012-en [Accessed December 2013].

26. Organization for Economic Co-operation and Development. (2013) *Main Science and Technology Indicators*. Available from: http://www.oecd-ilibrary.org/science-and-technology/main-science-and-technology-indicators_2304277x [Accessed December 2013].

27. World Bank. (2010) *Innovation Policy: A Guide for Developing Countries*. Available from: https://openknowledge.worldbank.org/bitstream/handle/10986/2460/548930PUB0EPI11C10Dislosed061312010.pdf [Accessed December 2013].

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