Asia-Pacific
Economic Cooperation

CASE STUDY REPORT

APEC PUBLIC-PRIVATE DIALOGUE ON SCIENCE, TECHNOLOGY AND INNOVATION:
Capitalize on Research and Development

Policy Partnership on Science, Technology and Innovation (PPSTI)

March 2020

APEC Project: PPSTI 01 2018A

Produced by

Association of Pacific Rim Universities（APRU）

For
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

TABLE OF CONTENTS

PART ONE: Background and Overview

Sharing economy and digital technology connectivity are both increasingly important building blocks of digital future and bring opportunities and challenges to inclusive development in APEC region. The project *APEC Public-Private Dialogue (PPD) on Sharing Economy and Digital Technology Connectivity for Inclusive Development* was initiated to host two seminars as PPSTI's first public-private dialogue that enables public and private sectors to jointly collect, analyse and study best practices and develop policy recommendations on how to reinforce public private partnership in digital future.

On February 12th, 2020, the second seminar of APEC Public-Private Dialogue on Sharing Economy and Digital Technology Connectivity for Inclusive Development (hereafter "Seminar 2020") was held in Putrajaya, Malaysia at the margins of APEC Senior Officials' Meeting (SOM) under PPSTI. The theme of this seminar is to Capitalize on Research and Development. Over the years, cross-disciplinary and cross-boundary research and development (R&D) activities have gained importance as channels through which to address complex global issues. This is especially relevant in the context of the Asia Pacific region, which comprises members at varying levels of economic development and distinguished by stark cultural differences.

This case study report examines a) best practices for capitalizing on R&D through public–private partnerships (PPPs), and b) suggestions that were presented by participants during Seminar 2020. The seminar initiated public–private conversations on topics related to promoting new technology adoption, covering amongst other things sectoral opportunities for investment, business strategies in R&D activities, and sustainable financial instruments. More than 50 speakers/participants/ representatives from the government, businesses and academia attended the seminar and they brought forward 14 best practices to the seminar and inspired attendees to explore how to strengthen the ecosystem for promoting research, development and commercialization of science and technology innovation through PPPs.

While PPPs have recently attracted increased interest, including in this seminar, it is important to remember that such partnerships are not new arrangements. Governments have for centuries partnered with private organizations to provide public services.[1] As such, the nature of these partnerships has also been evolving over a similarly long period of time. According to Bovaird (2004), the term "PPP" was first used about 40 years ago and, since then, has grown in prominence. According to Bovaird's (2004) broader, widely used definition, PPPs are "working arrangements based on mutual commitment (over and above that implied in any contract) between a public-sector organization with any organization outside of the public sector." Bovaird's broader definition of PPPs covers an assortment of organizational structures ranging from partnerships between central government agencies and companies to partnerships between local government departments and community groups. In his research, Weihe (2008) discusses various types and classifications of PPPs.[2] PPPs have existed for a long time but only recently have they been exploited to conduct and leverage R&D.

[1] Woodson (2016: 1411) quotes Wettenhall (2005) in describing how the Dutch East India Company was a partnership formed between the Dutch government and industry to encourage worldwide trade. During World War II, governments relied heavily on private industry to provide supplies and services for the war effort.
[2] PPPs provide a variety of functions such as policy design, policy evaluation and monitoring, implementation, capacity building, activism, and resource mobilization (Bovaird 2004; Brinkerhoff and Brinkerhoff 2011).

PART TWO: Cases Studied During Seminar 2020: **Best Practices** for Capitalizing on R&D Through Public–Private Partnerships (PPPs)

During Seminar 2020, speakers were invited to elaborate upon their best practices for capitalizing on R&D through PPPs. These best practices as well as a summary of all cases studied, are outlined below:

SESSION I: Building the Innovation Economy Through Collaborative Networks

Case 1-1: Emerging Technologies and STI Outlook: Organisation for Economic Co-operation and Development (OECD)

A speaker (the first in the seminar) from the Organisation for Economic Co-operation and Development (OECD) shared eight policy lessons from the OECD for capitalizing on R&D through PPPs.

First, when it comes to emerging technologies, those technologies are expected to have broad-ranging impacts across many fields of application, some of which cannot be anticipated in advance (consistent with the 'emerging' nature of the technology).

Second, given the unpredictability of technological change—including its impact on production and the pace of development and adoption—it is necessary to adopt an open and flexible perspective that supports a diversity of technology developments and applications.

Third, we must also keep in mind that despite the many calls from various sectors for more privately funded research, public research has in the past and continues today to play a pivotal role in developing emerging technologies in particular. Public-sector research provides new knowledge pertaining to phenomena that underpin emerging technologies, often contributes to prototype and demonstrator development, and nurtures many of the skills needed for further developing and exploiting emerging technologies.

Fourth, emerging technologies have—throughout history—often depended (and still do depend) on other technologies for their future development and exploitation. Technology convergence and combination are important and point to a need for cross-disciplinary institutional set-ups when considering PPPs—for example, for carrying out R&D work and offering skills training.

Fifth, given that the pace of technology diffusion is uneven and the direction in which it runs can change, the gap between frontier firms at the cutting edge of creating emerging technologies and laggard firms (that merely keep pace with the innovators) is widening.

Sixth, technologies do not function in isolation. If the benefits of technology are to be realized it is necessary that the introduction of a technology be bundled with investments in complementary assets such as new skills and organizational forms. Some observers would even

go so far as to assert that skills and organizational forms are part and parcel of the definition of 'new technology' (not just emerging technology).

Seventh, emerging technologies carry several risks and uncertainties. For PPPs to be successful, the public or private sector must take seriously ethical and moral issues raised by the introduction of an emerging technology.

Eighth, given all of the above, policymakers in charge of creating and running PPPs face the dual challenge of, on the one hand, fostering technological innovation, and yet on the other, of governing the same technological innovations they helped blossom in the first place. Sometimes these dual challenges can easily conflict with one another, placing policymakers in the unenviable position of having to choose one side or the other (either fostering or governing technological innovations).

Case 1-2: Future of Work: Association of Pacific Rim Universities (APRU)

Another speaker (the second in the seminar), from the Association of Pacific Rim Universities (APRU), described best practice for capitalizing on R&D through PPP as one that is built on multi-stakeholder engagement. To provide context for the APRU, it is important to understand that member institutions will not initiate R&D projects in the conventional sense but rather focus on projects that explore the impact of technology on society. Through such projects, the APRU informs policymakers on key aspects to support the development of relevant frameworks and policies. As such, one key benefit of APRU-backed projects is that the APRU approach enables governments in a given region to react more quickly to the impact and influence of new technological developments than they otherwise would be able to.

The speaker from the APRU presented the project, "Transformation of Work in Asia Pacific in the 21st Century" as their illustrative case study. This case showcased how research can be translated to support policymaking. The APRU case study was not however a traditional R&D case, but rather an introduction to a way of bringing together academics, experts, industry, and government to explore the impact of technology in supporting and informing policy developments across the Asia Pacific region. Multi-stakeholder partners include governments/policy experts contributing to, and engaging with, industry and academic experts. Bringing together the right partners for a project is an important role served by the APRU, given their neutrality. For academic partners in particular, the ability to access multi-disciplinary expertise (beyond just academic expertise) is a key advantage that enables successful outcomes to be delivered. The dissemination of key outputs involves partners from all three stakeholder groups to ensure that insights derived from projects inform policymakers and policy experts in key economies.

With multiple stakeholders engaged in PPPs, certain opportunities arise to raise the effectiveness of these partnerships, for example by maximizing the network effect (i.e. where multiple parties become involved with a view to improving the effectiveness of the system), increasing impacts (as a result of input from a diverse body of stakeholders), and marshalling additional resources (from each of the multiple stakeholders).

Case 1-3: STI Policy Governance: China: Embassy of the People's Republic of China in Malaysia

The speaker discussing STI policy governance in China presented one best practice for capitalizing on R&D through PPPs. This is the 'Technological Innovation Guiding Program' launched in China. This program encourages local governments—not just the central government—to contribute funds through the guidance of the central government, supporting state key laboratories of provincial–ministerial partnerships, thereby strengthening basic research conducted locally.

Speaker number three in the seminar discussed China's STI policies along several dimensions. First, this would involve reforming China's science and technology (S&T) system. Second, an innovation system would be constructed with enterprises as the locus of innovation activity, the market as a guide, and synergizing efforts from the tripartite combination of academia, research, and industry. Third, inputs into the S&T system would be increased, promoting comprehensive innovation in all fields and quality improvements targeted at upgrading the economy. Fourth, intellectual property rights (IPR) protection would be enhanced, more broadly to foster an innovation-friendly environment. Finally, the pool of top-level research scientists and engineers would be expanded. In 2005, China issued the *National Medium- and Long-Term Program for Scientific and Technological Development 2006~2020*, proposing the establishment of a technological innovation system in which enterprises would operate at the heart of the innovation system, collaborating with industry, academia, and research institutes with a view to enhancing the economy's innovation capabilities. As the end of the period of the medium-to-long-term plan approached in 2016, the *National Innovation-Driven Development Strategy* and the *13th Five-Year National Science, Technology and Innovation Plan 2016~2020* was issued to maintain the economy's momentum in the direction of developing its innovation system. The *National Innovation-Driven Development Strategy* comprises three targets: by 2020, China will enter the ranks of innovative economies; by 2030, China will lead the innovative economy category; and by 2050, for China will become an economy which is strong in S&T.

China has vigorously promoted the reform of the S&T system, made continuous efforts to improve the environment for innovation and entrepreneurship, and stimulated the enthusiasm and potential of innovators of all kinds. At present, China has formed an innovative system with four corners of interdependence between the government, enterprises, scientific research institutes and universities, and a technological innovation support service system. The reform of China's science and technology system has made important breakthroughs and substantial progress, focusing on promoting the integration of science and technology with the economy, strengthening scientific and technological innovation, promoting the transformation and industrialization of scientific and technological achievements, and restructuring and transforming mechanisms.

Apart from Chinese STI policies, the speaker also discussed international STI cooperation, mechanisms for achieving such cooperation (which include intergovernmental STI cooperation projects, international S&T cooperation platforms, exchanges of scientific and technological personnel, and foreign technical assistance) and China's participation in international mega science programs and projects (which include the International Thermonuclear Experimental Reactor (ITER), the Square Kilometer Array (SKA), the International Ocean Discovery Program (IODP), and the Human Genome Project (HGP)). The objectives of such international STI cooperation are fourfold: -

- To proactively integrate projects into the global innovation network.
- To carry out all-round, multi-tiered and high-level international cooperation and exchanges in STI to build a global network of partnerships and a community with a shared future for humankind.
- To create more points of convergence and growth areas for cooperation for win–win outcomes.
- To offer Chinese wisdom and Chinese approaches to solve common problems and challenges facing humankind.

The overarching principles under which cooperation takes place are equality, mutual benefits for all parties, outcome-sharing, and respect for IPRs.

Case 1-4: STI Policy Governance: Australia: Department of Industry, Innovation and Science, Australia

The seminar's fourth speaker, from Australia, elaborated on the importance of capitalizing on R&D through PPPs for an economy where the practical necessities (low population density, a competitive federalist system with each state having its own independent STI policies) dictate the creation of PPPs. In such a system, however, policy is not the end in and of itself. Policy has to be geared towards engaging with the research community, and there has to be connectivity between research and industry.

To capitalize on R&D, another best practice relates to research-funding activities and collaboration and commercialization activities. Research funding has to be given to the economy's research sector which works together with industry. Similarly, collaboration and commercialization activities (i.e. through collaborative research centers, industry growth centers, and R&D tax incentives) must be focused on the industry sector, which is connected with the economy's research sector.

Two best practices in Australian programs for capitalizing on R&D through PPP include: -

- Industry Growth Centers (IRCs) are designed to offer a number of key services to help Australian businesses grow and develop new innovations that can extend capabilities to other markets. IRCs work to optimize industry standards and harmonize regulations within certain sectors, identify knowledgeable partners to inform the research community about industry's needs, and provide advice regarding the skills needed within a given sector to take advantage of those new technologies. IRCs also provide a 10-year competitiveness plan to the government indicating how they will achieve growth. The government has funded six growth centers in 1) advanced manufacturing, 2) cybersecurity, 3) food and agri-business, 4) medical technology, 5) mining equipment technology and services, and 6) oil, gas, energy and resources. Each of these six areas matches domestic science and research priorities. Each area represents a sector where Australia has competitive strength but inadequate industry activity. Government support in each of these areas pursues a set cause. Uniquely, the government withdraws money from each of these centers over time, with the expectation that industry will continue to invest over that period. Government's role in establishing these centers is to kickstart innovation conversations, facilitate dialogue with the research community, and understand how capacity will be built in the Australian innovation ecosystem.
- A complementary government initiative is the Corporate Research Centers (CRCs). CRCs are challenge-based policy initiatives that industry, academia and, importantly,

small-to-medium-sized enterprises (SMEs) bring to government and government funds certain rounds of applications. Instead of government coming up with the challenge, they work as a collective to identify their own R&D requirements. CRCs bring together industry and the research community into one application. The Australian government assesses these applications in quite a unique way. In cases where there are two applications on the same topic but from different angles, the government encourages both applicants to come together and re-invites them to apply as a larger applicant, thereby growing those industry–research connections. Crucially, CRCs need to include SME engagement. This is about translating down to very small businesses what can otherwise be quite overwhelming in terms of the R&D capabilities needed to work with SME R&D needs and giving them a pathway to participate in large-scale R&D investment projects.

Case 1-5: Amplifying the Impact of Research in the 21st Century: Academy of Sciences Malaysia

The seminar's fifth speaker, from the Academy of Sciences in Malaysia, spoke about best practices for capitalizing on R&D through PPPs in Malaysia—with a focus on impact (rather than output alone). In this regard, Malaysia's R&D priority for the entire economy has to connect with socioeconomic development. To do that, Malaysia is now creating a collaborative network with a platform called 'i-connect' (similar to Australia's CRCs). This platform helps connect the public sphere with the private sphere, with the industrial partner leading the way. But the 'best practice' adopted by Malaysia is to involve a neutral entity that connects the public and private entities. The focus is on 10 technology drivers and 10 socioeconomic drivers.

10 technology drivers: -

a. 5G/6G
b. Sensor technology
c. 4D/5D printing
d. Advanced materials
e. Advanced intelligence systems
f. Cyber-security and encryption
g. Augmented analytics and data discovery
h. Blockchain technology
i. Neuro technology
j. Gene-editing and modification

10 socioeconomic drivers: -

a. Energy security
b. Business financial services
c. Culture arts and tourism
d. Medical and healthcare
e. Smart technology and systems (next-generation engineering and manufacturing)
f. Smart cities and transportation
g. Water and food security
h. Agriculture and forestry
i. Education
j. Environment and biodiversity

These 10-by-10 technological/socioeconomic drivers are known as the "10–10 STIE Framework". It represents a technology-oriented view of the world mapped against Malaysia's socioeconomic drivers. The key best practice brought to the table through this 10–10 STIE Framework is to ensure impact by design rather than by chance. In other words, the focus on impact is built in from the inception of this framework, rather than studied as an afterthought along the way, or at the end of an initiative.

Case 1-6: Enabling Research Connectivity Through Open Science: International Science Council Regional Office for Asia and the Pacific (ISC ROAP)

The seminar's sixth speaker, the director of the International Science Council's regional office for Asia and the Pacific, elaborated on best practices for capitalizing on R&D through PPP. These include, fundamentally, three parallel initiatives: -

- World Data System (WDS) – promoting long-term stewardship of, and equitable access to, quality-assured scientific data and data services, products, and information.
- Committee on Data for Science and Technology (CODATA) – improvement of the quality and accessibility of data as well as of methods through which data are acquired, managed, and analyzed; facilitation of international cooperation; and promoting increased awareness.
- International Network for the Availability of Scientific Publications (INASP).

A second-best practice for capitalizing on R&D through PPPs, mentioned by the director of the International Science Council Regional Office for Asia and the Pacific (ICS ROAP), is the African Open Science Platform. This platform is fully funded by the National Research Foundation (NRF) (SA Dept of Science and Technology), directed by CODATA (ISC), and managed by the Academy of Science of South Africa (ASSAf) through the ASSAf's hosting the ISC Regional Office for Africa (ISC ROA). It was launched in 2016 with pilot deliverables, the African open data forum, a framework for open data policies, a framework for incentives for sharing research data, a framework for capacity building in research data, a framework and roadmap for e-infrastructure, and a landscape report on Open Data in Africa.

SESSION II: Enterprising Future Technologies Through Public–Private Partnership (PPP)

Case 2-1: Business Model and Prospects for Emerging Technologies: ABAC Principal Advisor for APEC PPSTI

ABAC's principal advisor for APEC PPSTI focused his presentation on the 'wider agenda'. The idea is that, if the objective is creating an enabling environment that stimulates innovation to promote growth that in turn drives the economy and recognizes STI as a critical pillar in economic planning, then it is necessary to look at the wider agenda which weaves the key elements of the innovation and technology ecosystem into the design and planning of cities. Such an agenda represents a more holistic approach to creating integrated S&T districts and communities. Parks and Campuses have their role as individual components of the ecosystem but there is a need to address society's wish to live, work, play, and learn in a close-knit

environment. As such, we cannot conceive of STI in isolation and need to identify a much more comprehensive approach which adopts the following features: -

- Adopts a 'people-first' approach that creates livable, affordable, and vibrant neighborhoods for all stakeholders.
- Attracts and nurtures a world-class talent pool and provides the quality of life, safety, and public-amenity ingredients they are seeking.
- Introduces next-generation infrastructure driven by smart technologies.
- Uses these new districts and communities as exemplars and living laboratories for new technologies.

Thereafter, ABAC's principal advisor for APEC PPSTI discussed the application of the abovementioned best practices in the case of "Inno137 Hong Kong, China", which is designed to be its most vibrant, innovation-led neighborhood (in the area of Tseung Kwan O in Hong Kong, China) powered by an urban business community and talent pool. Its objective is to develop into Hong Kong, China's first 'people-first' community for work and recreation—a vibrant innovation-led neighborhood powering the city's economy. Inno137 is designed as an independent and self-sustaining community to attract, catalyze, and unleash innovation. The quadruple pillars for Inno137 are designed to: -

- Establish technology industries of the future—driving Hong Kong, China's 'digital future' through forward-thinking infrastructure and a vibrant innovation and technology ecosystem.
- Nurture a world-class talent pool—as part of Hong Kong, China's and the Greater Bay Area's (GBA) innovation-driven development strategy.
- Foster a vibrant living community—supporting the next generation by putting people first, through access to affordable housing and amenities
- Improve the lives of Hong Kong, China's people—reinvigorating livelihoods through job generation, education, safety, and open public spaces.

The vision is for Inno137 to be a home, in Tseung Kwan O, for 1,000 to 1,500 companies, 50,000 to 80,000 new jobs, and 10,000 to 15,000 new homes. The design of Inno137 runs along three main spines: -

- A waterfront boulevard—a dynamic stretch of innovation facilities and corporate campuses, along a seafront promenade accessible to all.
- An innovation avenue—an energetic ecosystem housing continuous learning, collaborative platforms, and varied residences and leisure services for the talent community.
- A hillside drive—a dynamic cluster of progressive, clean, advanced manufacturing facilities and technology laboratories.

The ultimate vision is for Inno137 to act as a testbed for the use of 'smart city' urban and social technologies, setting new benchmarks as a study test-case for Hong Kong, China. Within this vision, the Hong Kong Science and Technology Park plays a pivotal role by leading with innovation via their skillset and record of success, through managing the overall project as master agent and planner to coordinate best-in-class partners, and by giving back to Hong Kong, China and contributing to the economic and social growth of the city and its role within the GBA in becoming an international innovation and technology hub.

Case 2-2: Role of Policymakers in Promoting Future Technology, Taking Autonomous Vehicles as a Case Study: Metal Industries Research & Development Centre

The seminar's eighth speaker, the deputy chief of Chinese Taipei's Metals Industry R&D Center (MIRDC), discussed the role of policymakers in promoting future technology by using the example of autonomous vehicles (AVs). The best practice taken from this example of technology is for policymakers to provide comprehensive guidance for and services to the development of innovation. This policy guidance however should not—and does not—come from policymakers alone; rather, the guidance also has to come from relevant private-sector stakeholders tasked with maintaining innovation. Both parties are important if R&D is to be capitalized through PPP.

The case study presented by this speaker is the development of AVs in Chinese Taipei. Since 2019, AV development has been confronted with a sobering reality: namely, producing safe AVs still faces many technical and legal issues. As a result, AV manufacturers are facing severe challenges and have had no choice but to revise downwards their originally radical deployments and ambitious goals for autonomous driving. Under these circumstances, the role for policymakers and their policy is even more important. Chinese Taipei's policymakers have launched a project called 'Autonomous Vehicles Technology Innovative Experimentation in Chinese Taipei'. By targeting four objectives, this project aims to develop, apply, and build a sound and safe innovative experimental environment for promoting the development of AV-related industrial technology and innovative services: -

- Objective 1: Encourage R&D and the application of AV technology.
- Objective 2: Create a sound and safe environment for innovative experimentation.
- Objective 3: Advance development of industrial technology and innovative services.
- Objective 4: Promote worldwide autonomous tests of and knowledge exchange for AVs in Chinese Taipei.

As internationally valid AV verification standards have not yet been produced, and the domestic traffic environment in Chinese Taipei is highly complex, roads for domestic self-driving vehicle verification must be established. The development of these roads has been facilitated with the Unmanned Vehicles Technology Innovative Experimentation Act. Going forward, in 2020 and beyond the policy recommendations are: first, to establish a robust sandbox program to experiment with, and calibrate, policy in a 'safe' environment; second, open science can be called upon for STI capacity-building and smart transportation policy implementation.

Case 2-3: SMEs and Domestic Economic Development: Reddal Inc.

Seminar 2020's ninth speaker, from Reddal Inc., reoriented the focus towards the macro or aggregate picture when SMEs are involved in domestic economic development. By employing empirical examples from across the Asian region (but mostly Korea and Viet Nam), the speaker delivered four key messages: -

- To understand the drivers of domestic economic growth, we must understand the role of an economy's population, the nature of the economy's productivity, and the nature of exports.

- The role of domestic policy impacts SMEs. In particular, Korea pursued import substitution (using interventionist/protectionist strategies to drive manufactured goods exports by subsidizing target industries and related chaebols), while Viet Nam pursued a complementary strategy (with government policy aiming to help local SMEs to become multinational corporation (MNC) suppliers). Avoiding the original equipment manufacturing (OEM) trap is even more critical for SMEs in developing economies given that their advantage in manufacturing, arising out of cheap labor, will gradually diminish. Distinct domestic policy choices have varying impacts on SMEs.
- Korean SMEs are often trapped in a vicious cycle, accepting their role as local suppliers. The transition to a virtuous cycle requires engaging in more time-consuming, costlier, and uncertain R&D and internationalization. Without a dedicated entry strategy, many young companies fall into the pitfalls of relying on the 'sales' approach only for short-term gain. SMEs in developing economies need a path-creation strategy, where internationalization is an integral part of success.
- The role of a policy ecosystem and the need for end-to-end coverage, rather than just focusing on one part of the development journey, must be emphasized. Here, the key point is that the success of an economy is not only about economics—it connects to both political and economic institutions. Furthermore, the basic idea is that innovation is driven by freedom and creativity. In this regard, institutions can improve innovation by incentivizing a greater number of people to participate in innovative activity. Inclusiveness is a key element in the early stages of development, but the overall policy ecosystem must also meet requirements down the line. That is to say, the policy ecosystem must be adapted in lock-step with the ever-changing innovation ecosystem. Even though Korea's economic policy has actively extended itself across all development stages, it has not yet adequately addressed the issue of weak SMEs. The Viet Namese government's regulatory support has focused on improved credit access and reduced administrative burdens (with the impact of recent new measures to enhance SME capabilities yet to be seen). In Viet Nam, the various recent stimulus packages have encouraged the formation of new SMEs supported by bank lending; however, whether or not their development is sustainable remains unclear.

To conclude, this speaker emphasized that learning from the past and learning from others (i.e. the Korean experience and the Viet Namese experience) is possible, but the future is likely to bring fresh challenges for which new, holistic, solutions will be needed. Because growth is becoming increasingly difficult—the past does not provide clear recipes for the future—economies must forge their own paths. In particular, a manufacturing-led export-growth strategy is being severely challenged. Population growth is a clear driver of GDP growth, but it needs to be combined with productivity growth; economies must avoid the low-labor-cost trap that has negative effects on productivity as well as, potentially, inequality. Korea's, state-run industrial policy, which favors only a small number of large corporations, is perhaps not a successful strategy in the long term (compared particularly with the German industrial ecosystem, and the strong role of 'Mittelstand' companies). Viet Nam's experience, on the other hand, may be a cautionary lesson in excessive dependence on FDI, with insufficient attention to building the economy's own industrial ecosystem (leading to a weak SME sector, as in Korea). As a baseline rule, Asian companies seeking to innovate should leverage their inherent advantages in a creative way. That being said, political and economic inclusiveness is critical to success—it implies including most members of society (also immigrants and their overseas diasporas). To develop a growing economy, though, its policy ecosystem must address the needs of the entire company-development path. Piecemeal solutions do not work, which is necessarily a far more challenging policy agenda for policymakers to take on board.

Case 2-4: Value Creation Through Academia-Industry Linkages: Collaborative Research in Engineering, Science and Technology (CREST)

The seminar's tenth speaker, the CEO of Collaborative Research in Engineering, Science and Technology (CREST), an NGO dedicated to promoting collaborative research in S&T, spoke about value creation through academia–industry linkages. CREST is an example of a neutral entity introduced by the speaker from the Academy of Sciences in Malaysia that are involved in connecting public and private entities. The raison d'etre for CREST is intervening in and solving common challenges faced by MNCs and local companies. The common challenges include: -

- Mismatches in research areas at universities seeking to solve technical problems in industry
- Lack of supply of industry-relevant talent
- Lack of shared facilities to serve immediate industry needs

As a neutral entity, CREST helps create a world-class ecosystem because of the high level of trust it is able to endanger in both public parties and their private counterparts. It is not considered or viewed as taking 'sides' favoring one or the other. As a neutral entity CREST: -

- Bridges the gap between academia and industry
- Offers a single platform that both academic and industrial partners can utilize
- Promotes demand-driven research in industry
- Helps generate a pool of domain experts
- Optimizes resource allocation
- Shares knowledge to drive R&D and innovation in the electrical and electronics (E&E) sector

CREST fosters a collaborative R&D ecosystem through the creation of an industry-led collaborative platform for market-driven R&D. While CREST is industry-led, its member representation is the triple helix of government, industry, and academia. Since 2012, CREST has built a solid infrastructure of 145 approved R&D projects, 85 industry and university members, 14 shared facilities, 20+ hosted starts at CREST's technology startup incubator, 2000+ databases of subject-matter experts, and 10,000 university and industry talents.

In building its collaborative R&D ecosystem, CREST adopts a three-phase strategy for engaging with stakeholders to enrich the research ecosystem in the E&E sector from ideas to research to implementation.

- Phase 1 (Seeding): Focus on industry-driven research, growing talent, and partnering with universities
- Phase 2 (Cluster Focus): Focus on technology clusters, growing SMEs through collaboration with academia, and generating business value
- Phase 3 (Take off): Create a world-class research ecosystem, create local technopreneurs, and generate capital flow in the E&E sector

Key takeaways from CREST's experience: -

- To collaborate successfully, it is essential to establish a neutral platform that can be trusted. This yields transparency through strong governance structures and offers clear,

concise messaging regarding activities that represent one's community. Furthermore, it is expedient.

- The support network can come from unexpected places. It is necessary to have a strong board with knowledge and foresight. A Triple Helix model means three kinds of stakeholders each with its own needs.

Case 2-5: Financing and Incentivizing Green STI : Malaysia Green Technology Corporation (MGTC)

Seminar 2020's eleventh speaker, the CEO of Malaysia Green Technology Corporation (MGCC), made a presentation on the subject of financing and incentivizing green STI by discussing government financing and incentives for STI R&D in Malaysia. According to market research, green technologies' market value was roughly USD 6.9 billion in 2018. It is anticipated that this will rise at a rate of 27% annually thanks to growing environmental awareness as well as rising consumer and industrial demand for a healthier and more sustainable approach to life. Therefore, demand for companies providing green and sustainable solutions is very strong. As a result, Malaysia has put much effort into securing financial support for green tech companies.

Financing—especially in the early stages—is an important aspect and governments must be sources of new ideas as well as commercialization. Financing is a central issue for innovative entrepreneurs as well as policymakers. Startups and SMEs face financial constraints typically because of the potential risks to their innovation. The MGCC steps in to help solve problems such as gaps between investors and entrepreneurs. Some entrepreneurs also suffer from resource constraints, insufficient collateral, or lack of credit. The quality of a business plan is also influential in funding decisions.

Other policies, such as subsidies and tax deductions, are also in place. Subsidies are very effective at mitigating financial constraints. Seed funding can not only help SMEs mitigate financial constraints, it can also help them navigate the initial stages when it is difficult to access capital.

The key best practice to be taken away from the MGCCs experience and case study is that policymakers have a key role to play on two fronts: -

- Promoting a diverse set of innovative companies, covering the spectrum from basic research to companies engaged in commercialization activities.
- Offering a policy package to support all steps from basic research straight through to commercialization.

The case study presented was related to 'Syngas', which the government financed and to which it provided incentives for STI R&D in Malaysia. The project was designed to convert waste plastic into commercial Euro 5 diesel oil. Starting in May 2009, the project ran until January 2014 when the plastic-to-diesel conversion technology was officially registered for intellectual property protection by the Malaysia Intellectual Property (MyIPO) Office. Ultimately, the IP of Syngas Conversion Technology was patented in 61 economies worldwide. This led to the awarding of the Malaysia National Innovation Award (2014) and Malaysia' Top 30 Green Catalyst Award (2015). Total government financing and incentives amounted to USD2.8 million for the project (divided across government grants, government agency soft loans, a government agency revolving fund, and government incentives).

Case 2-6: Financing and Incentivizing Emerging Technologies: Malaysia Investment Development Authority (MIDA)

The next speaker, from the Chemical and Advanced Materials Industries Division of the Malaysia Investment Development Authority (MIDA), discussed its role and practices. The MIDA performs three main functions, including: -

a. Promotion
    - One-to-one meetings
    - Seminars and briefings
    - Data on industries
    - Meetings with companies operating in Malaysia
    - Visits to production facilities and service providers
    - Visits to potential locations
b. Approval
    - Manufacturing licensing
    - Tax incentives
    - Expatriate posts
    - Import duty exemptions
    - Representative/regional office
    - Principal hub
c. Implementation
    - Handholding by MIDA state offices
    - Industry Talent Management
    - Post Investment

Investment policies offered by the MIDA include 100% equity ownership, the ability to repatriate income, employment of expatriates, manufacturing licenses, IPR, and investment guarantee agreements (IGAs).

Best practices adopted by the MIDA include offering companies in the manufacturing sector pioneer status, investment tax allowances, reinvestment allowances, and import duty/sales tax exemptions. Other incentives include automation capital allowances, domestic investment strategic fund (DISF) support, an intervention fund, and customized packages.

The MIDA also offers a range of facilitation services. Through its investment coordination platform (ICP), the MIDA provides a range of advisory services and facilitations to companies for business expansion or diversification plans. These include business match-making, raising capital (debt and equity), initial public offerings (IPOs) and joint ventures and M&A divestment.

Case 2-7: R&D in Enterprises: Inari Amertron Berhad

Seminar 2020's penultimate speaker was the COO of Inari Amertron Berhad. Inari was established in 2006 as a leading provider of semiconductor packaging and testing services for radio frequency (RF) wireless devices. It was listed on the Malaysian stock exchange in 2011. By 2019, Inari had become the largest technology company in Malaysia, with market

capitalization exceeding 5 million Malaysian Ringgit. As a major private-sector corporation, Inari's major best practice includes offering one-stop fully turnkey services to its clients, ranging from design and development to NPI qualification to high-volume manufacturing to shipping. The goal is to offer clients—whether they are private firms, government agencies, or academic institutions—collaborative engagement opportunities.

The R&D activities in Inari include: -

- Establishing customized semiconductor packaging processes, such as wafer probing, thinning, inspection. and die singulation
- Customized assembly packaging and testing
- Development of specific new processes required for new product variants, such as EMI shielding, wafer-level solder printing, etc.
- Process characterization and optimization and support of NPI builds
- Process qualifications and readiness for HVM operations

Inari works with clients to develop packaging solutions, assembly processes, and testing processes. The best practice here is that products are owned by customers for end-customers. The captive and collaborative Out-Sourced Assembly and Test (OSAT) performed by Inari involves Inari's collecting information/requirements from customers which they use to execute and respond in collaborative, interactive, and real-time fashion. The customers provide Inari with product requirements through EBR, initiate material selections, specify process requirements, determine the test conditions and expected result boundaries, interactive disposition, and product analytics for iterations. Inari executes/responds by assuring that the process platform meets EBR, sourcing and procuring materials, implementing real-time control and assurance-process recipes and limits, developing/executing test conditions, performing test parameters, providing real-time status, and undertaking process analytics and iterations.

A final best practice of Inari is to adopt Industry 4.0 into its operations, comprising: -

- Digitalization (a comprehensive front-to-end MES system that controls, triggers, and alerts).
- 'Datamation' (automatic and real-time data upload from equipment, testers, and processes).
- 'Cognitivity' (visualization dashboards with detail analytics).
- Remote co-development (remote accessibility and full function control from customer's-end direct-to-machines display and control).

Case 2-8: R&D in Enterprises: Mensilin Group of Companies

The final speaker at Seminar 2020, the CEO of Mensilin Group of Companies, discussed waste-to-wealth technology solutions. In particular, the plastic-to-fuel (ptf) project teaser was discussed. The ptf represents a revolutionary catalytic thermal de-polymerization technology.

Continuing with the Syngas case presented earlier in the seminar (by the MGTC), the CEO of Mensilin discussed the types of waste plastic that are converted into ultra-low-sulfur diesel fuel in Syngas conversion systems. These include: -

- High Density Polyethylene (HDPE): Liquid laundry detergent, shampoo, conditioner, and motor oil bottles; pipes, buckets, crates, flower pots, garden edging, films and

sheets, recycling bins, benches, dog houses, plastic lumber, floor tiles, picnic tables, fencing.

- Low Density Polyethylene (LDPE): Shipping envelopes, garbage can liners, floor tile, furniture, films and sheets, compost bins, paneling, trash cans, landscape timber, lumber.
- Polypropylene (PP): Automobile battery cases, signal lights, battery cables, brooms, brushes, ice scrapers, oil funnels, bicycle racks, rakes, bins, pallets, sheeting, trays.
- Polystyrene (PS): Thermometers, light switch plates, thermal insulation, egg cartons, vents, desk trays, rulers, license plate frames, foam packing, foam plates, cups, utensils.

The characteristics of Syngas' waste plastic-to-ULSD fuel continuous conversion systems include: -

- Converting residual and waste plastic into feedstock for the circular economy
- Award-winning, globally patented, proven, and operational technology
- Modular, scalable, and transportable
- Simple platform integration and assembly at any site
- Low feedstock cost, power consumption, and operational expenses
- ASTM-compliant ULSD fuel production
- Reducing landfill waste and abundant feedstock available
- Manufactured in Malaysia with available turnkey EPC solutions

PART THREE: Cases Studied During Seminar 2020: **Suggestions** for Capitalizing R&D through PPP

In addition to best practices, seminar speakers were also invited to offer suggestions regarding what more can be done to help capitalize R&D through PPP. These suggestions are summarized as follows: -

Suggestion 1: Organization for Economic Co-operation and Development (OECD)

- Create the right conditions for the development of emerging technologies
- Aim to introduce regulations at the correct time
- When implementing regulations, strike a balance between 'right regulations' and 'de-regulation'
- Embed governance 'upstream'

Some of the best suggestions were presented by the OECD. To capitalize on R&D through PPP, governments need to create conditions that are conducive to the development and diffusion of trusted and trustworthy technology with broad and beneficial impacts for the economy and society. Suggestions regarding what more can be done to capitalize on R&D through PPPs include overcoming the following challenges related to various technologies: -

- Pacing: For technologies that are rapidly evolving and have unclear impacts (i.e. artificial intelligence).
- Disruptive: Technologies that have economy-wide impacts (i.e. Uber).
- Misfit: For technologies that cannot be governed by existing legal categories (i.e. neurotechnology).
- Enabling: Technologies that impact larger areas of work.

To capitalize on R&D through PPP, a balance has to be struck in terms of when (and what kinds of) regulations should ideally kick in. If governments decide to regulate earlier in the R&D process, the full consequences of a technology might not be fully apparent, raising the risk of misguided or inadequate regulation. This can lead to unnecessary regulation that constrains R&D and innovation. On the other hand, if governments decide to regulate later, then changing course may become expensive, difficult, and time-consuming because a technology is built into the market (the 'lock-in' effect). Furthermore, 'end-of-pipe' solutions can come too late and not be as effective (as earlier intervention).

To capitalize on R&D through PPP, governments have to move from 'deregulation' to the 'right kind of regulation'. This view is echoed even by the biggest private firms such as Facebook, whose founder, Mark Zuckerberg, in his testimony to the US Congress in April 2018, stated, "my position is not that there should be no regulation. [. . .] I think the real question, as the Internet becomes more important in people's lives, is what is the right regulation, not whether there should be or not."

Preventing, correcting, or mitigating potential negative effects of innovation while still allowing entrepreneurial activity to flourish and reaping the benefits of innovation is a key challenge facing policymakers today. In this vein, suggestions for policymakers include: -

- Not separating the facilitation of innovation from the question of governance.
- Adjusting innovation systems to include governance dimensions.
- Moving governance concerns 'upstream' (not from 'end-of-pipe') (see elaboration, below).
- Increasing resonances with the private sector.

Embedding governance 'upstream' in the innovation process comprises three important dimensions: -

- Anticipation: The capacity to anticipate, and respond to, public concerns or changing circumstances along a given trajectory while enhancing resilience (i.e. the capacity to withstand shocks and changes in environment). On the public side, companies need to mitigate against potential public backlash.
- Inclusion: This refers to governing the goals and impacts of innovation democratically. The implications for innovation-based economies are that they represent a broad range of voices and values (including those of non-experts and affected publics) in the governance of science and innovation, and also include diverse actors in the design and scale-up phases.
- Directionality: This calls for 'directed' and 'purposive' transformative innovation by connecting innovation to, for example, the UN's sustainable development goals; mission-based innovation as well as public procurement of innovation and other demand-side instruments.

Suggestion 2: Association of Pacific Rim Universities (APRU)

- Involve multiple stakeholders in projects
- Work diligently to overcome difficulties of involving multiple stakeholders

The APRU speaker discussed suggestions for capitalizing R&D through PPPs. From their case, "Transformation of Work in Asia Pacific in the 21st Century", the APRU's suggestions included: -

- Considering the long-set up period required for effective PPPs (especially for non-run-of-the-mill projects).
- Adapting to, and overcoming the challenges brought about by, the contrasting working cultures of the public and private sectors; flexibility is required most when other stakeholders have reached a tipping point where there is no room to maneuver.
- Ensuring adequate and effective dissemination and application of results generated by PPPs; planning for the dissemination and application of research-related projects to be built into project plans (bringing in the right partners from the outset is one effective way of eliminating this challenge); impact is *not* achieved simply with an exciting report collating insights from key experts; dissemination must be carried out through *all* of the engaged partners, via varied channels, across stakeholder groups, with broad coverage (industry can be a very good partner for this).
- Identifying an experienced project lead who can corral and manage multidisciplinary experts and is committed to delivering the key project outputs is essential for success.
- Bringing together multiple stakeholders to collaborate maximizes impact through a project's partners. Multi-stakeholder projects facilitate the flow of knowledge between engaged parties. While academic experts learn and benefit from engaging with

colleagues across academic disciplines, these projects also increase understanding and knowledge across stakeholder groups and thus guide future research areas.

Suggestion 3: Academy of Sciences Malaysia

- Reconceptualize the language and terminology surrounding 'open science'; adopt and build trust in open science
- Shift focus away from 'output' (or performance) to 'impact'

Another speaker, from the Academy of Sciences in Malaysia. spoke about the need to revisit our understanding of the terms, terminology, and/or language associated with PPPs. Indirectly, this can help economies capitalize on R&D through PPPs. Specifically, there are many in the arts and humanities who do not like the term 'open science'. But what we mean by open science is that all this information is meant for sharing to enhance a scientific and technological project. It is becoming more and more difficult to conduct research on one's own, so the future with regards to PPPs is about partnering, about collaborating, about enhanced collaboration and frequent information-sharing. PPPs—which can otherwise be known as creating collaborative networks—are also very important. Now more than ever there is a need to link the research priorities in an economy to demonstrable impacts of research.

Another approach to capitalizing R&D through PPPs involves shifting our focus away from performance to *impact*. As such, the future of research is looking for KRIs, or Key Research Impacts rather than the outdated KPIs, or Key Performance Indicators. KPIs are only about performance and output, not necessarily connected to impact. Concomitantly, research funding needs to change in terms of emphasizing the impact of research (rather than output only). This extends to how research is monitored, reviewed, evaluated, etc. Therefore, to capitalize on R&D through PPP, impact must be emphasized. Impact means the effects on or benefits of a technological change on the economy, on society, on culture, on public policy, on public services, on health, on the environment, on areas beyond academia. Another definition of impact is the demonstrable (rather than expected) contribution to the economy and/or society. There are many ways of measuring impact, such as understanding whether any change has been made in people's attitudes, or in its influence on the economy, social aspects, policy, culture, policymaking, etc. This focus on impact is necessary because when impact is emphasized and measured, the *process* of a PPP or a piece of research is downplayed in favor of the overall focus or objective of that research or PPP. If a change in impact can be made then R&D can be better leveraged through PPPs.

A final suggestion offered by this speaker is that a focus on building trust should be adopted. Only when and where there is trust can we expect to see the impacts of PPPs. With trust comes integrity, which translates into respectable conduct in research. This means emphasizing research integrity and enforcing a researcher's code of conduct. When research data are collected in ethically appropriate ways, the integrity of the data and users is heightened, allowing a PPP that takes advantage of that research to use it in a more meaningful manner.

Suggestion 4: International Science Council Regional Office for Asia and the Pacific

- Adopt open data practices

The director of the ISC ROAP spoke about what more can be done to help capitalize on R&D through PPPs. This approach revolves around data. To leverage PPPs effectively, data are crucial. Research data are the new currency. Therefore, there have to be well established principles governing data usage. These include FAIR (Findable, Accessible, Interoperable, Reusable) principles. As data become a commodity, privacy also becomes an important issue to consider. In this regard, the OECD's principles for research data from public funding are worth remembering. These principles include openness, flexibility, transparency, legal conformity, and protection of intellectual property. To implement these principles, it is necessary to build an open-science ecosystem (which fosters open data).

Suggestion 5: Collaborative Research in Engineering, Science and Technology

- Build an industry-driven R&D ecosystem and earn broad buy-in from stakeholders

One important suggestion regarding what more can be done to capitalize R&D through PPPs was offered by the CEO of CREST. That is, CREST's model of success in the E&E sector needs to be replicated across geographies and industries. Each industry-driven R&D ecosystem for a specific region should be driven through an incubation platform started in one location and replicated in other locations.

CREST also suggested developing a strategy that earns everyone's buy-in and an execution plan that is pragmatic. To capitalize R&D through PPP, stakeholder buy-in is imperative and a program designed to involve all stakeholders must be customized as one size does not fit all. Furthermore, such a customized program must also evolve continuously over time. Specifically, such a program needs to be revisited and revised every two years, and the changes brought about must be effectively communicated to all parties involved.

PART FOUR: Conclusions

The 'Public–Private Dialogue on Science, Technology and Innovation' brought together stakeholders in STI to strengthen ecosystems that support R&D and commercialization in sectors related to STI. The 'Seminar 2020' under study in this report initiated public–private conversations on topics related to promoting new technology adoption.

According to the OECD, a PPP can be understood as an "agreement between the government and one or more private partners according to which the private partners deliver the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners" (OECD 2008: 12).

The 14 cases presented at the seminar fell into two categories: the six presented in the first session focused on building the innovation economy through collaborative networks and the eight presented in the second session focused on enterprising future technologies through PPPs. The cases in the first session were more macro in their perspective from the viewpoint of supra-national organizations such as the OECD, the APRU, and the ISC as well as economy cases—China, Australia, and Malaysia. The cases reviewed in the second session were more micro in their perspective, pertaining in scope to smaller economies (such as Hong Kong, China) or specific technologies (such as autonomous vehicles), certain economic sectors (such as SMEs or larger enterprises), particular linkages (such as academia–industry links), or certain technologies (such as emerging and green tech).

Overall, the quality of cases was very high and each presented case offered a unique, non-overlapping vantage point from each speaker. Combined, the cases served to adequately address the overall conference theme. Indeed, given the wide variety of cases (in terms of economies covered as well as economic sectors), the cases complemented one another well. Each case addressed a unique facet or feature of a way to capitalize on R&D (the seminar theme).

A few of the cases provided detailed suggestions for overcoming the challenges that stand in the way of capitalizing on R&D. The suggestions offered were necessarily more directly applicable from the unique perspective offered by each speaker, but combined the suggestions highlighted a 'pathway' that can be taken to help capitalize on R&D more effectively.

A key takeaway from all the cases is that organizations who presented in the session must make the necessary effort to cooperate with the different regional associations and groups that can harness funding for R&D projects. These projects can involve the private sector and various universities and government agencies. This may include, for example, R&D on biomedical devices (i.e. ventilators, respirators, etc.) including a framework for fast-tracking mobilization of medical and/or emergency relief using the resources and expert laboratories of member economies. The overriding message has to be one for all organizations to attempt to increase their relevance, particularly to the needs of the times, and reallocate resources when necessary. Such agility will allow the organizations to build stronger ties and mitigate the impact of current or potentially future (emerging) crises.

Woodson (2016: 1411) outlines three rationales behind the formation of or need for PPPs that are helpful to keep in mind when understanding the importance of PPPs for R&D. First, the increasing scientific and technological complexity and interconnectivity of problems prohibit

an organization from accomplishing its goals on its own. As such, organizations hoping to succeed must form partnerships (McQuaid 2000; Van Ham and Koppenjan 2001).[3] Second, a group of organizations can better overcome market deficiencies (related to the incentive problem for conducting R&D) than a single actor can. PPPs can spread the risk of failure—which is high for R&D projects, especially those carried out on the frontier of scientific and technological developments—over multiple parties and projects (for example in some cases where innovations face high technical risk that prevent them from being economically attractive, while other innovations generate low monetary returns; Greve 2006). Third, PPPs also improve economies of scale to facilitate R&D and pool talent across sectors (Bovaird 2004). Independent organizations may not have the scientific and technical expertise, personnel, or financial resources to manage, evaluate, and implement multiple highly technical projects (Moran et al. 2010).

PPP policies and institutions have increasingly diffused across a broad range of economies (Vining et al. 2005; Hodge et al. 2010). Earlier scholarship has shown that establishing PPPs depends on a wide range of factors, including political commitment (Flinders 2005), fiscal conditions (McQuaid and Scherrer 2010), and the presence of a supportive legal framework (Tvarnø 2006). In other words, institutional elements in the business environment can facilitate or hinder the development and success of PPPs.

Indeed, the response of governments to the rise of PPPs has been similarly varied. Whereas some domestic governments have developed extensive partnership programs and embarked on widespread PPP development, others have remained skeptical (Verhoest et al. 2013). This seminar demonstrated multiple ways in which R&D can be leveraged in APEC economies through PPPs. The seminar's speakers emphasized that PPPs can indeed be effectively leveraged to encourage R&D, advance scientific projects, and enhance favorable economy-wide outcomes (such as economic growth, job creation, competitiveness, etc.).

[3] The need to partner to cope with increased complexity is especially relevant for organizations working with highly scientific emerging technologies. These technologies operate at the forefront of knowledge, and a variety of sectors must share knowledge to develop them (Cozzens et al. 2010).

Supporting Documents and References

The websites at which all speakers' presentations can be found are:

http://www.mestecc.gov.my/web/apecppsti2020

https://drive.mestecc.gov.my/index.php/s/YWNMtEXZXtj9jyE#

References:

Bovaird, T., 2004. Public–private partnerships: from contested concepts to prevalent practice. *International review of administrative sciences*, *70*(2): 199-215.

Brinkerhoff, D.W. and Brinkerhoff, J.M. 2011. Public–private partnerships: perspectives on purposes publicness, and good governance. *Public Administration and Development*, 31: 2–14.

Cozzens, S.E., Gatchair, S., Kang, J., Kim, K.-S., Lee, H.J., Ordónez, and G., Porter, A. 2010. Emerging technologies: quantitative identification and measurement. *Technology Analysis & Strategic Management*, 22(3): 361–376.

Flinders, M., 2005. The politics of public–private partnerships. *The British Journal of Politics and International Relations*, 7(2): 215-239.

Greve, C., 2006. Public–private partnerships: a public policy perspective. In: Hodge, G.A. (Ed.), *Privatization and Market Development: Global Movements in Public Policy Ideas.* Edward Elgar, Cheltenham: 63–77.

Hodge, G. A., Greve, C., and Boardman, A. E. (Eds.). 2010. *International Handbook on Public-Private Partnerships*. Cheltenham: Edward Elgar.

McQuaid, R.W. 2000. The theory of partnership: Why have partnerships? In *Public-private partnerships: Theory and practice in international perspective*, edited by S. P. Osborne, 9–36. New York: Routledge.

McQuaid, R.W. and Scherrer, W. 2010. Changing reasons for public–private partnerships (PPPs). *Public Money & Management*, 30(1): 27-34.

Moran, M., Guzman, J., Ropars, A.L. and Illmer, A. 2010. The role of product development partnerships in research and development for neglected diseases. *International Health*, 2: 114–122.

OECD. 2008. *Public-private partnerships: In pursuit of risk sharing and value for money*. Organization for Economic Cooperation and Development. Paris.

Tvarnø, C.D. 2006. Public-Private Partnerships from a Danish Perspective. *Public Procurement Law Review*, 3: 98-108.

Van Ham, H. and Koppenjan, J. 2001. Building Public–Private Partnerships: assessing and managing risks in port development. *Public Management Review*, 3:593–616.

Verhoest, K., Carbonara, N., Lember, V., Petersen, O.H., Scherrer, W., and Van den Hurk, M. 2013. Public Private Partnerships in Transport: Trends & Theory P3T3. *Discussion Papers part I, COST*.

Vining, A.R., Boardman, A.E. and Poschmann, F. 2005. Public–private partnerships in the US and Canada: "There are no free lunches". *Journal of Comparative Policy Analysis: Research and Practice*, 7(3): 199-220.

Weihe, G. 2008. Public-private partnerships and public-private value trade-offs. *Public Money and Management*, *28*(3): 153-158.

Wettenhall, R. 2005. The public–private interface: surveying the history. In: Hodge, G.A., Greve, C. (Eds.), The Challenge of Public–Private Partnerships: Learning from International Experience. Edward Elgar, Cheltenham: 22–43.
Woodson, T. S. 2016. Public private partnerships and emerging technologies: A look at nanomedicine for diseases of poverty. *Research Policy*, 45(7): 1410-1418.