

A multipronged approach to innovation: The Mauritius Case Study

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Abstract Innovation is broadly defined as the creation or adoption of new ideas and technologies, which has become an instrumental tool to determine the success and development level of a country as it leads to competitiveness and productivity of companies. Innovation is influenced by many factors including geographic and socio-economic factors as well as a political framework. In fact, innovation is systemic in nature, and it focuses on interactions amongst a nexus of processes such as Research and Development (R&D), production, business, and education, amongst other factors. However, not all innovation ecosystems have the same architectural models or internal collaboration. This paper aims to review the structure of the National Innovation Ecosystem by highlighting the different actions taken by the Government of Mauritius over the years. The multipronged approach of the government will be demonstrated through the different lines of actions to boost the innovation culture and offers a foundation for other small island developing state to follow to be at par with other innovative economies.

Keywords Systemic innovation, Research and Development, Funding, Education, Technologies, National innovation Ecosystem

I. Introduction

Small Island Developing States (SIDS) are disadvantaged by their small size and remote location. They are also impacted by climate change and natural disasters. Land size and lack of human capacity can be challenges to large-scale

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industries and entrepreneurship. Indeed, innovation can help to alleviate the challenges faced by SIDS.

Mauritius is a SIDS positioned at 2,000 km from the east coast of mainland Africa and is striving to become an innovation-driven nation. Since the past few years, the government has initiated a number of actions to boost its National Innovation Ecosystem. Consequently, the ranking of Mauritius had a notable rank change from 82nd (out of 130 economies) to 52nd (out of 131 economies) position in the Global Innovation Index in 2020 and now ranks first in Sub-Saharan Africa (Cornell University and WIPO 2019; 2020).

In the global context, innovation has become instrumental for determining the success and the development level of a country as it is an important factor with regards to the competitiveness and productivity of companies (López-Cabarcos et al., 2020). The systemic nature of innovation stressing interlinkages between processes such as R&D, production, business and education has overridden the concept of linear innovation starting with basic research followed by applied research, production and diffusion, respectively (Midgley and Lundhult 2017; Suurs and Elsbeth Roelofs, 2014). In Organisation for Economic Co-operation and Development (OECD) countries, systemic approaches have provided new perspectives with regards to their innovation and economic performance. Traditionally, technology-related analysis focuses on inputs and outputs. For example, input can be research expenditure, and output can be patents (OECD, 1997). However, the OECD report (1997) stresses that interactions between the stakeholders in technology development are of crucial importance for the efficient translation of inputs into outputs. Effective implementation of policies, access to international markets, and robust intellectual property (IP) protection are key to innovation output.

In this paper, the multidisciplinary approach of the Republic of Mauritius to synergize efforts across sectors such as R&D, education, emerging technologies, and Information, Communication and Technology (ICT) to boost its National Innovation Ecosystem will be presented. The importance of linkages and partnerships as a driving force to strengthen the Mauritian Innovation Scoreboard (MIS) is highlighted. The approach of the Government of Mauritius could be a role model for other SIDS to overcome their inherent challenges through a strong National Innovation Ecosystem.

II. Methodology

This study was mainly a desktop review of available documentation such as publications including case studies, official reports, and websites. Scientific

pieces of literature were collected using databases and search engines such as ScienceDirect, Springer and Scopus

III. Review of policies implemented in Mauritius

Innovation is essential for long-term economic growth and improved quality of standards of living (Gerguri, S. and Ramadani, V., 2010). Over the years, the Government of Mauritius has identified and implemented the most appropriate portfolio of support instruments that has boosted the innovation ecosystem. These include funding and linkages, promoting R&D in the industry, boosting entrepreneurial attitude, promoting capacity building, investment in new technologies and having an appropriate governance. These initiatives are further elaborated on in the sections below.

1. Funding and Linkages

R&D is one of the important pillars of the National Innovation Ecosystem to ensure technological potential, innovation and economic growth (Bayarçelik and Taşel., 2012). The positive relationship between investment in R&D, level of development and economic performance is well documented. (Hall, 1996; Sadraoui and Zina, 2009; Wakellin, 2001; Isametdinovna and Naimovna, 2020). In fact, it has often been demonstrated that there is a positive correlation between the R&D intensity (i.e., R&D outlays/GDP) and the level of development. Accordingly, many country policies have increased their levels of R&D funding for science and technology to impact their economic growth (Argentino, 2010).

In the case of Mauritius, two major R&D gaps are funding and collaboration between industry and academia which is reflected in the ranking of Mauritius for the “Gross expenditure in R&D” and “University/industry research collaboration.” The rankings for these two indicators ranged from 88th to 107th (out of 126 to 131 economies) in the Global Innovation Index from 2018 to 2020, placing Mauritius in the lower half of the ranked countries (Cornell University and WIPO, 2018-2020). In fact, in the GII report 2018, the indicator of “gross expenditure on R&D” was considered a weakness for the economy, showing that the country appears to be underperforming in R&D with respect to the size of its GDP (Cornell University and WIPO, 2018).

The Government has an important role to play in driving the national innovation system, especially in emerging economies. Hence, to promote R&D in Mauritius, special R&D and innovation funds have been earmarked by the

Government to promote Research, both in the public and private sectors. National Innovation funds, amounting to MUR125-150 million, have been earmarked annually over the past three years, and a National Research Fund of MUR 50 million since 2018 for academic research (Mauritius Research Council, 2019). These major R&D funds are managed by two institutions respectively: the Higher Education Commission (HEC), which falls under the purview of the Ministry of Education, Tertiary Education, Science and Technology (MoETECS), and the Mauritius Research and Innovation Council (MRIC) operating under the Ministry of Information Technology, Communication and Innovation (MITCI). Both institutions have developed a number of funding schemes to assist Research and Innovation in academic institutions and industry including startups.

- (i) Direct measures, especially schemes for direct support, are becoming more and more popular amongst policymakers to stimulate R&D (Aerts and Schmidt, 2008). Consistently, the MRIC, which has the responsibility to promote innovation as well as commercialization of research at the national level, has promoted academia-industry linkages through its schemes. A number of funding schemes operating on a matching grant basis, that is Industry and Government, share the risks of innovation by investing matching funds in innovative projects (Ministry of Information Technology, Communication and Innovation, 2018) that can lead to innovative products/processes/ideas with commercial potential and generation of new knowledge through research.

Innovative business ideas and the promotion of entrepreneurship are being supported through the National SME Incubator Scheme (NSIS). The Proof-of-Concept Scheme (PCS) allows companies to prove their concepts. Collaborative RDI projects are being pushed forward through the Collaborative Research and Innovation Grant Scheme (CRIGS) and the Research and Innovation Bridges (RIB). Centres of Excellence in focused areas are supported through the Pole of Innovation Grant Scheme (PoIGS). Emphasis is also given to the societal issues through targeting funding under the Social Innovation & Research Grant Scheme (SIRGS) and providing advisory support for intellectual property under the Intellectual Property Promotion Scheme (IPPS) (Ministry of Technology, Innovation and Communication, 2018).

With this measure, the MRIC reported an increase in the number of projects it has funded under matching grant schemes; from 41 new projects in 2016/2017 to 85 new projects in 2018/2019, while private sector expenditure on R&D has increased from MUR 16.9 million to MUR 92.67 million rupees in that same time span (Mauritius Research Council, 2019). These measures have impacted

positively on the participation of Industry in Research and Development and have helped to bridge the gap between Academia and Industry. Academia/industry/Government partnerships are known to have synergy while allowing sharing of resources and experience and covering various institutional and legal framework that support and allow for R& D at the same time (Schacht, 2010). This approach allows the development of new resources, facilities, knowledge, and skills. However, there is still more to do to consolidate this type of R&D, and this calls for additional measures to increase industry participation.

One main industry actor in Mauritius is Small and Medium Enterprises (SMEs), generating 40% of the local GDP and 55% of the workforce (Ministry of Business, Enterprise and Cooperatives, 2017). SMEs operate at low subsistence levels and might not have enough funds to invest in the existing research and innovation funding schemes that operate on a matching grant basis (Ministry of Technology, Communication and Innovation, 2018). In addition to financial constraints, SMEs often lack sufficient expertise and capacity to make use of external knowledge, which is essential for R&D and innovation (Hiroyuki et al., 2019). Contrary to larger enterprises, SMEs do not have the necessary assets for innovation such as accessibility to external resources and intellectual property protection (Cockburn and Henderson, 2001; Ceccagnoli et al., 2010; Hall and Ziedonis, 2001). In this case, the Government could promote subsidized R&D collaboration between SMEs, research institutions and academia, for example, through the implementation of innovation voucher programs. A comprehensive database linking SMEs with other firms, academic, and public research institutes could facilitate this collaboration. Building networks with investors and banks could provide SMEs open access to investment opportunities (Nishimura and Okamuro, 2011).

2. Promoting R&D in the private sector

Promoting industry investment in R&D through relevant policies and institutional/regulatory frameworks has been a priority for policymakers and academics (European Commission, 2003; 2004; 2020). In this line, Mauritius still has to improve in terms of Research and Development performed and financed by a business. This could be highly felt by the poor performance of Mauritius in the indicators related to R&D in the private sector including “Gross Expenditure in Research & Development (GERD) performed by business” and “GERD financed by business,” with ranks 83rd and 90th respectively in the Global Innovation Index 2020. The GII Report 2020 clearly highlights that these two indicators are indeed weaknesses for Mauritius (Cornell University and WIPO, 2020).

The Industrial Policy and Strategic Plan for Mauritius (2020-2025) clearly emphasizes the fact that it is crucial to incentivize Mauritian manufacturers to undertake high-value R&D activities such as ideation, product and service design, product or service development, testing, and prototyping (Ministry of Industrial Development, SMEs and Cooperatives and United Nations Conference on Trade and Development, 2020).

Hence, since 2017, new policies have been introduced to attract R&D investment from industry and foreign companies (Ministry of Finance and Economic Development, 2017). One such measure is the Industrial Property Bill 2019 to consolidate the protection of Intellectual Property Rights in the context of a globalized industry. This should encourage companies to invest in R&D without fear of other enterprises making use of their investment (Madhou et al., 2021). Otherwise, there is the risk that firms do not benefit from the returns to innovation, causing the social returns to R&D to be higher than the private returns (Hall et al., 2010).

Another major measure by the Government to encourage private firms to invest in Research and Innovation has been the introduction of tax incentives in 2017, whereby company R&D expenses are deducted from their taxable revenues (Ministry of Finance and Economic Development, 2017). R&D tax incentive policies have been in place for so many years in France, Canada, the United States, Australia and Norway, and other OECD countries and stimulate firms' incremental R&D spending (Ming-Chin, C. and Gupta, S., 2017). In fact, in 2017, R&D tax incentives accounted for around 0.10% of GDP and 55% of the total (direct and tax) Government support in the OECD area (Appelt et al., 2020). Undoubtedly, properly designed tax reliefs can incentivize research in small and medium-sized enterprises (SMEs).

The Regulatory Sandbox License (RSL), introduced in Mauritius in the National Budget 2018/2019, is considered one of the many levers used by the Government to help encourage businesses to invest in R&D. Alongside, a National Regulatory Sandbox License Committee has been set up under the purview of the Financial Services Commission of Mauritius (FSC), the regulator of non-financial and global business services. The Investment Promotion Act was amended in October 2016 to provide for guidelines to be issued by the Economic Development Board (EDB) with regards to application and selection criteria. The guidelines also set conditions for license revocation and suspension and mechanisms for project approval, monitoring, and reporting. This measure should boost the innovation ecosystem by allowing technology transfer in the country. It has been reported that at least 9 startups/companies operating in

services such as cryptocurrency, online peer-to-peer lending and blockchain have been granted regulatory sandbox licenses (Tim, 2021).

It is strongly believed that administrative framework, government regulations, and public policies can also impact the innovation performance of firms and enterprises. Regulation that removes the administrative burden that prevents entrepreneurs from focusing on their innovative activities was implemented through the Business Facilitation Bill in 2017. The Business Facilitation Bill provides for amendments to the legislative framework that is necessary for the removal of constraints in relation to permits, licenses, authorizations and clearances to facilitate further the Ease of Doing of Business and for related matters in Mauritius (Mauritius Research Council, 2019). This is further reflected in the World Bank, ‘Doing Business’ ranking, where Mauritius evolved from 42nd in 2016, to 42nd in 2017 to 25th in 2018 to 20th in 2019, 13th in 2020 (World Bank Group, 2016-2020).

3. Boosting the entrepreneurship attitude

Competivity among enterprises has increased in recent years with the globalization of markets and Industry 4.0. In order to respond quickly to market needs, enterprises should operate more efficiently and need to develop a “healthy” cultural environment within the organization that allows the implementation of new ways of work. Hence, innovation capacity, as well as an organizational culture promoting entrepreneurial behavior, is important for companies to stay in the competition (Martins et al., 2018).

Entrepreneurship focuses on the discovery, evaluation, and exploitation of opportunities in the process of business startup, creation and growth (Majdoulina, 2020) and leads to economic growth and diversification. This enhances the structural transformation and industrialization, which leads to inclusive and sustainable socio-economic development (United Nations, 2016). An increasing number of entrepreneurs leads to the transformation of the economy as well as helps to achieve the targets of the Sustainable Development Goals (particularly Goal 8) (United Nations, 2016).

Based on this perspective, it is crucial for Mauritius to help its youth to adopt an ‘entrepreneurship attitude’ as a means to inculcate an innovation culture in its population. Hence, the SME 10- year Master Plan, launched in the year 2017 (Ministry of Business, Enterprise and Cooperatives, 2017) has a number of measures to promote entrepreneurship. These include the use of successful entrepreneurs as role models for youth as well as the setting up of physical

infrastructure, incubators, and industrial parks to facilitate the business success of entrepreneurs.

The National SME Incubator Scheme (NSIS) was launched by MRIC to promote the initiation and development of innovative startups facilitated by a network of industry-led accredited business incubators. This scheme ensures a structured training/mentoring approach to developing prototypes and startups in three different phases, which include ideation, incubation and acceleration. The scheme has catered for 213 projects and graduated 15 startups since 2017 (Mauritius Research and Innovation Council, 2021).

In parallel, measures have been taken to mainstream entrepreneurship education in the National Education Curriculum. There are presently 10 public and 44 private universities in Mauritius. Three of these universities have been reported to provide entrepreneurship courses at the undergraduate level (Roopchund, 2020). The courses provided by these universities address the lack of entrepreneurial skills in Mauritius and support the creation of small businesses/startups, an important step in inculcating an entrepreneurial and innovation culture in Mauritius (Roopchund, 2020). The University of Mauritius (UoM) has started to develop the concept of an entrepreneurial university with new activities such as the UoM Agri Tech Park, which aims at modernization of agriculture as a collaborative venture between public and private sectors. The UoM has also spelled out its intention to groom 'Eco Entrepreneurs' and assist them in developing sound business plans and clear business models (University of Mauritius, 2020).

4. Building up capacity

Schools are at the crossroad of innovation and hold a central position in 'learning' and 'schooling' while at the same time positioning them within broader ecologies of local and regional innovation ("innovation ecosystems" (OECD, 2017). Hence, the education sector in Mauritius is putting much effort into supplying the human capital required to transform the island into an innovation-driven economy. Efforts have been made throughout the system right from primary up to tertiary levels. There have been some major policy measures taken by the Government over the past three years to provide for more creativity at an early stage during primary education and hence the introduction of the nine-year schooling system from 2017 (Mauritius Research Council, 2019).

The Nine Year Continuous Basic Education (NYCBE) announced in 2016 emphasized the early years of primary education and new methods of assessment, allowing students to progress toward a vibrant Technical and Vocational Education. Besides the effort to offer a revamped polytechnic

education, the Government has, through the Early Digital Learning Programme, aligned integration of ICT into teaching and learning for primary school pupils and promoted an early culture of Information Technology (IT) usage (Ministry of Education, Tertiary Education, Science and Technology, 2020). The Government is also investing 48 million in the Digital Youth Engagement Programme, which is aimed at providing courses in coding to students at primary levels (GIS, 2018). To date, 5,046 primary students have already benefitted from this program.

Secondary education is free in Mauritius and compulsory for all up to the age of 16. The Ministry of Education, Tertiary Education, Science and Technology (Ministry of Education, Tertiary Education, Science and Technology, 2021) oversees secondary education, which is a 7-year cycle. All students who have completed the first six years of basic education (Grades 1 to 6) in their primary school move on to Grade 7 in a secondary school. At the completion of their Grade 9 studies, which is equivalent to completion of lower secondary studies, students who do not have the possibility to move on to Upper secondary education can opt for Technical and Vocational Education and Training (TVET). TVET can eventually lead to the award of National Certificates, National Diplomas or Higher National Diplomas in specific fields. It is worth mentioning that entrepreneurship education has become mandatory in secondary schools since 2020 (Roopchund, 2020).

In the Higher Education sector, a major milestone has been the announcement made by Government to provide free tertiary education since January 2019. A second milestone was the proclamation of the Higher Education Act in 2017 with a number of measures for a well-regulated education system, hence paving the way for the internationalization of higher education (Mauritius Research Council, 2019). This can be reflected in the establishment of international awarding bodies and branches of international universities in Mauritius. Some examples are Ecole Nationale Supérieure d'Architecture (ENSA) de Nantes (France), VATEL (France), University of Kent (UK), University of London (UK), and Utah State University (USA) among others. It is further noted that there are presently branches of three international universities established in the country; these are Middlesex International (Mauritius) Ltd (UK) and Greenwich University, Pakistan (Mauritius Branch Campus) (Pakistan), and African Leadership College (Higher Education Commission, 2021).

Consistent with internationalization efforts, the number of international students has increased over the last 10 years. In 2019, this trend was maintained as enrolment increased by 8.4% to 2,579, up from 2,380 in 2018. Out of the 2,579 enrolled, a majority were enrolled in private tertiary education institutions

(2,189; 84.9 %). The international students came from 69 different countries, with the main source countries being India, Madagascar, Nigeria, South Africa, Kenya, Zimbabwe, France, and Tanzania (Higher Education Commission, 2020). This could be partly attributed to the Mauritius Africa Scholarship Scheme which was initiated in Mauritius in 2020. 50 scholarships have been offered to deserving students from African countries (Mauritius Research Council, 2019).

5. Investing in New Technologies

New technologies have the potential to spur innovation, leading to inclusive and sustainable growth. Over the past few years, it has been observed that most technologically sophisticated developing countries are emerging as significant innovators (Dutz and Sharma, 2012). In fact, technologies have been proven to be important assets in helping countries to recover from disruptions caused by the COVID-19 pandemic.

A strong ICT sector is of utmost importance in promoting innovation. Companies are applying innovative solutions, for instance, through the Internet of Things, cloud computing, miniaturization and 3D printing. These solutions enable better interoperability, more flexible industrial processes, and autonomous and intelligent manufacturing (Li, 2017). The ICT sector has, for a number of years, been one of the most dynamic sectors in Mauritius with a long phase of growth of over 10% annually (Mauritius Research Council, 2019). The Government has taken a number of measures to facilitate the transition of Mauritius into a fully-fledged digital society. A number of initiatives have been implemented by the Government to move the ICT sector forward. These include increased access to the digital world through the deployment of fiber to the home, and now, more than 300 000 households have access to fiber-based services as well as globally interconnected infrastructure linked by submarine cable systems (Mauritius Telecom, 2021).

Besides investing in connectivity, the country is also investing in new and emerging technologies. One major step in that direction has been a historic move for Mauritius, which envisions engaging in the spheres of space and satellite technology as part of its national development agenda. Conceptualized by Mauritian Engineers, the first Mauritian NanoSatellite MIR-SAT1 was deployed into orbit from the International Space Station (ISS) (International Telecommunication Union, 2021). This major achievement could be the first step for Mauritius to advance in other sectors and allow efficient mapping and monitoring of the resources, ecosystems, and events. The information can be

used for various scientific, administrative, and commercial applications. For instance, satellite data can be used to identify factors that influence crop yield or identify areas prone to flooding in real estate.

The Government has, through the Budget Speech 2021/2022, demonstrated its commitment toward building up capacity for emerging technologies. Hence, the creation of an Emerging Technologies Council has been announced; the Council will act as a Centre of Excellence in emerging technologies and promote high-quality research in this new avenue (The Mauritius Emerging Technologies Council Bill, 2021).

The intention of the Government is also clearly spelt out in the application of digital technologies to facilitate entrepreneurship. In this perspective, an important measure in the Budget Speech 2021/2022 (Ministry of Finance, Economic Planning and Development, 2021) is the Digital Business Facilitation. The Economic Development Board (EDB) will launch the following to support local businesses/encourage/boost Mauritian entrepreneurship:

- An online marketplace for startups to showcase their products and services.
- Launching of an e-export Directory to display to the world products manufactured by Mauritian entrepreneurs. The matchmaking platform will facilitate trade between Mauritius, Africa, and Asia.

6. Governance

The measures taken by the Government can only function in the presence of a proper institutional framework. It is worthwhile mentioning that since 2014, the Government of Mauritius has also mandated a specific Ministry to oversee innovation, the Ministry of Information Technology, Communication, and Innovation. In September 2019, the Mauritius Research Council (MRC) was revamped into the MRIC, presently operating under the aegis of the latter Ministry. With this new change in the organization, the MRIC has the additional responsibility of empowering the promotion of high-quality research and fostering innovation.

For the first time since 2018, the Ministry of Information Technology, Communication and Innovation has developed a Mauritian Innovation Scoreboard (MIS) (Ministry of Technology, Communication and Innovation, 2018). The Scoreboard consists of 38 indicators falling under the pillars:

- i. Human resources
- ii. Finance and support
- iii. Innovation rate
- iv. Bibliometric indicators

The Scoreboard allows the collection of data and formulation of evidence-based recommendations in relation to the innovation ecosystem. This tool has been most crucial in the improvement in the ranking of Mauritius from 82nd to 52nd in the Global Innovation Index, as the report alludes to a “mix of new data availability, data revisions at the source, and performance effects” (Cornell University and WIPO, 2020), demonstrating the importance of data in evaluating and boosting innovation performance. Hence, besides allowing policymakers to make sound and evidence-based decisions, the tool is also useful in the global benchmarking of Mauritius in the Global Innovation Index Reports.

IV. Implications for policymaking

An agile innovation ecosystem should be adapted to changes, both internal and external to the system; hence it should be able to continuously realign its synergistic relationships (Still et al., 2014). The situational analysis conducted in this study contributes to the conceptual debate on innovation ecosystems by providing empirical insights into how the initiatives taken by the Government of Mauritius, together with other stakeholders, have clearly contributed to boosting the Mauritian Innovation Ecosystem. However, as effective the Mauritian Innovation ecosystem seems to be, it can still be argued that other policy drivers are missing in the existing framework that can literally cope with and sustain a competitive advantage as in other innovative economies. The GII reports published by Cornell University and WIPO over the last 5 years demonstrate that even though Mauritius ranks well in innovation inputs, it still needs to improve its performance in innovation outputs, including Knowledge and Technology outputs (Cornell University and WIPO, 2017-2020). This requires a more efficient system embedded in relevant policies which can translate innovation inputs into outputs.

It is widely recognized that collaboration is a key factor in the effective translation of innovation investment into innovation output. Collaborative innovation has been a key piston in the engine driving economic growth (Saguy, 2011). This term was popularized by Gloor (Gloor, 2006) and further explored conceptually (Camarinha-Matos and Afsarmanesh, 2008) and empirically (Nieto and Santamaría, 2007; Tsai, 2009) by other authors. In fact, it has been

shown in the literature that collaborative innovation can facilitate the creation, exchange, and transfer of knowledge in dynamic ecosystems, resulting in improved competitiveness (Schroth and Jakob Häußermann, 2018). Even though innovation strategies are being implemented by various Ministries and organizations in Mauritius, the collaboration mechanism is not clear. Institutions operate ‘in-solo,’ and there is no common infrastructure or working place allowing active physical interactions. Enhanced collaboration can be achieved through infrastructure such as fab labs which provide co-working spaces where policymakers, companies, and citizens can join hands and share ideas to give rise to innovation (Duh and Kos, 2016). This kind of infrastructure has also proven to be successful in the development of new policies and boosted innovation ecosystems. Hence, policy labs, where multidisciplinary government teams develop public services and policies using cross-fertilized innovative methods such as coproduction, cocreation, codesign, systems thinking, and ethnography, have been set up in many countries in the European Union (Whicher, 2021). Such working spaces could be platforms for Ministries and organizations to be involved in the different initiatives of the Mauritius Innovation Ecosystem to rationalize efforts in a coordinated approach.

Another aspect that might require the attention of policymakers in Mauritius is a technological innovation in the Small and Medium Enterprises (SMEs). These SMEs operate on low turnovers and might not have enough resources to tap in the different innovation grants and funding schemes. This warranties measures are important to catalyze innovation in SMEs and facilitate market access. Innovative policy procurement measures facilitating market access to SMEs have proven to be a successful policy tool in many European countries (Hoekman and Tas, 2020). These measures include public procurement, regulation, supporting private demand, and systemic policies. As a response to this measure, SMEs can cluster and collaborate to bring the required product or service to the market.

An organized approach promoting collaboration at various levels will no doubt increase the performance of the Mauritius Innovation Ecosystem. The implementation of policy measures in that direction will lead to an increased conversion rate of innovation input into output and, ultimately, an efficient National Innovation Ecosystem.

V. Conclusion

This snapshot of the Mauritius Innovation Ecosystem article demonstrates the multi-pronged approach to boosting innovation in a country. This study adds to the empirical literature on innovation by its analytic approach and identifies a

portfolio of economic factors that influence innovation. Our analysis of educational, political, financial, and business environments with the most potential for innovation can be used for effective resource allocation in the required sectors or institutions. Incentives such as subsidies, tax breaks, grants, or business incubation services can be used to boost innovation. Moreover, it also highlights the contribution of industry in increasing the R&D expenditure and innovative efforts of a country. Internationalization and ownership of technology innovation were identified as key factors which can result in economic growth. This study also highlights the importance of having an integrated curriculum that guides students to adopt an innovative mindset and focuses on the development of the required skills that promote entrepreneurial behavior. In addition to all measures taken at the level of the Government, there is a need to focus on enhancing the quality of education to facilitate the knowledge transfer needed for country-level innovation. There is also a need to implement policies for enhanced collaborative innovation through fab labs or policy labs. Facilitating access of SMEs to public procurement can impact positively on the technological innovation of small firms.

This present pandemic has also shown us that an additional feature, flexibility, should be integrated into the system. Since the COVID-19 pandemic started in 2020, countries have had the daunting task of having to find new and innovative ways to support their companies and communities. Digitalization technologies have been crucial in helping countries to face the disruptive impacts of COVID-19; hence, digitalization has become an important element to be considered in an innovation ecosystem.

One of the lessons learned from the unexpected pandemic is that resilience and adaptability should be integrated into the national innovation ecosystem to buffer any unpredicted event to adapt to ‘disruptive innovation.’

References

- Aerts, K., Schmidt, T. (2008). Two for the price of one? Additionality effects of R&D subsidies: A comparison between Flanders and Germany. *Research Policy*, 37, 806-822.
- Appelt, S., Bajgar, M., Criscuolo, C., Galindo-Rueda, F., (2020). Effectiveness of R&D tax incentives in OECD economies. <https://voxeu.org/article/effectiveness-rd-tax-incentives-oecd-economies>
- Argentino, P. (2010). R&D and economic growth: How strong is the link, *Economics Letters*, 107, 152–154.
- Bayarcelik, E.B. and Taşel, F. (2012). Research and Development: Source of Economic Growth. *Procedia - Social and Behavioral Sciences* 58, 744–753.
- Camarinha-Matos, L.M. and Afsarmanesh, H. (2008). *Classes of collaborative networks*. G.D. Putnik, M.M. Cruz-Cunha (Eds.), *Encyclopedia of Networked and Virtual Organizations*, IGI Global, Hershey, PA (2008), pp. 193-198.
- Ceccagnoli, M., Graham, S.J., Higgins, M.J. and Lee, J. (2010), Productivity and the role of complementary assets in firms' demand for technology innovations. *Industrial and Corporate Change*, 19 (3), 839-869.
- Cockburn, I. and Henderson, R. (2001). Scale and scope in drug development: Unpacking the advantages of size in pharmaceutical research. *Journal of Health Economics* 20(6), 1033-1057.
- Cornell University, INSEAD, and The World Intellectual Organisation (2017). *The Global Innovation Index Report 2018*. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2017.pdf, accessed April 2021.
- Cornell University, INSEAD, and The World Intellectual Organisation (2018). *The Global Innovation Index Report 2018*. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2018.pdf, accessed April 2021.
- Cornell University, INSEAD, and The World Intellectual Organisation (2019). *The Global Innovation Index Report 2019*. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2019.pdf.
- Cornell University, INSEAD, and The World Intellectual Organisation (2020). *The Global Innovation Index Report 2020*. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020.pdf.
- Cornell University, INSEAD, and The World Intellectual Organisation (2021). *The Global Innovation Index Report 2021*. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021.pdf, accessed September 2021.
- Duh, E.S and Kos, A. (2016). Fablabs as Drivers for Open Innovation and Co-creation to Foster Rural Development, *2016 International Conference on Identification, Information and Knowledge in the Internet of Things (IIKI)*, 214-216, doi: 10.1109/IIKI.2016.70.
- Dutz, M.A. and Sharma, S., (2012). Green Growth, Technology and Innovation, *World Bank Policy Research Working Paper No. 5932*, Available at SSRN: <https://ssrn.com/abstract=1980586>
- European Commission (2003). Investing in Research: An Action Plan for Europe. https://ec.europa.eu/invest-in-research/action/2003_actionplan_en.htm

- European Commission (2004). Facing the Challenge: The Lisbon Strategy for Growth and Employment. Report from the High Level group. <https://op.europa.eu/en/publication-detail/-/publication/88b6bc81-e3ad-4156-960f-f549369aa9d4>
- European Commission: Europe 2020 (2020). A Strategy for Smart, Sustainable and Inclusive Growth, Brussels. sustainabledevelopment.un.org/index.php?page=view&type=99&nr=16&menu=1449#:~:text=Development%20Knowledge%20Platform-,Europe%202020%3A%20A%20Strategy%20for%20Smart%2C%20Sustainable%20and%20Inclusive%20Growth,efficiency%20by%20the%20year%202020
- Gerguri, S. and Ramadani, V. (2010). The Impact of Innovation into the Economic Growth, *Munich Personal RePEc Archive*. <https://mpira.ub.uni-muenchen.de/22270/>
- GIS (2018). <http://www.govmu.org/English/News/Pages/ICT-Digital-Youth-Engagement/Programme-amounting-to-Rs-4.8-million,-launched.aspx>
- Gloor, P.A. (2006). *Swarm Creativity: Competitive Advantage Through Collaborative Innovation Networks*. Oxford University Press, New York, NY, Google Scholar.
- Hall, B. H. (1996). The private and social returns to research and development. In Bruce L.R. Smith & Claude E. Barfield (Eds.), *Technology, R&D, and the Economy* (140-183). Washington, D.C.:Brookings Institution Press.
- Hall, B. H., Mairesse, J., Mohnen, P. (2010). Measuring the returns to R&D. In: Hall, B.H., Rosenberg, N. (Eds.), *Handbook of the Economics of Innovation*, (1033–1082).
- Hall, B.H. and Ziedonis, R.H. (2001). The patent paradox revisited: An empirical study of patenting in the U.S. semiconductor industry, 1979-1995. *RAND. Journal of Economics*, 32 (1), 101-128.
- Higher Education Commission (2020). A Snapshot of the Higher Education Participation status in Mauritius. https://www.hec.mu/pdf_downloads/news/hec_snapshot_tei_booklet.pdf
- Higher Education Commission (2021). Private Higher Education Institutions in Mauritius. <https://www.hec.mu/hei>, accessed September 2021.
- Hiroyuki, O., Junichi, N., Massim, C., Erik, S., (2019). Promoting SME R&D and Innovation. *SME Policy Faced with Development of Financial Technology*.
- Hoekman, B. and Taş, B.K.O. Procurement policy and SME participation in public purchasing. *Small Business Economics* (2020). <https://doi.org/10.1007/s11187-020-00414-z>
- International Telecommunication Union (2021). Mauritius deploys first satellite into low-Earth orbit. <https://www.itu.int/en/myitu/News/2021/06/22/09/19/Mauritius-deploys-first-satellite-low-Earth-orbit-KiboCUBE>, accessed September 2021.
- Isametdinovna, K. and Naimovna, A. (2020). R&D Expenditure as A Factor In The Development Of The Economy Of Knowledge. *The American Journal of Interdisciplinary Innovations and Research*, 2(12), 9-16.
- Li, Y. (2017). How ICT infrastructure is crucial to achieving the SDGs in the era of the fourth industrial revolution, <https://news.itu.int/ict-infrastructure-crucial-achieving-sdgs-era-fourth-industrialrevolution>
- López- Cabarcos, M.A., Piñeiro-Chousa, J. and Quiñoá-Piñeiro, L. (2020). An approach to a country's innovation considering cultural, economic, and social conditions. *Economic Research-Ekonomska Istraživanja*, 34(1), 2747-2766.
- Madhou, M., Heeramun, P., Moosun, S.B. and Naginlal Modi-Nagowah, D. (2021). Using R&D indicators to shape a small island innovation ecosystem. *The ISPIM*

Innovation Conference – Innovating Our Common Future. Berlin, Germany on 20–23 June 2021. Event Proceedings: LUT Scientific and Expertise Publications: ISBN 978-952-335-467-8.

- Majdouline, I., El Baz, J., Jebli, F. (2020). Entrepreneurship orientation and innovation linkage: the case of Moroccan firms, *Projectics*, 1(25), 27-45.
- Martins, J.M., Abreu., A. and Calado, J. (2018). The Need to Develop a Corporate Culture of Innovation in a Globalization Context, *Globalization, George Yungchih Wang, IntechOpen*, DOI: 10.5772/intechopen.81266. Available from: <https://www.intechopen.com/chapters/63716>
- Mauritius Research and Innovation Council (2021). National SME Incubator Scheme (NSIS). <http://www.mric.mu/English/News/Pages/National-SME-Incubator-Scheme-NSIS.aspx>.
- Mauritius Research Council (2019). An Analysis Based on The Global Innovation Index. *Innovate Mauritius*. [http://www.mric.mu/English/Documents/MRC_REPORT_27_JUNE_2019%20\(1\)-compressed.pdf](http://www.mric.mu/English/Documents/MRC_REPORT_27_JUNE_2019%20(1)-compressed.pdf)
- Mauritius Research Council (2019). Annual Report July 2018 to June 2019. https://9843d706-9eaa-44a6-9914-8c85a3203bbc.filesusr.com/ugd/d4e70d_967f0b1c99b1465db05092218927ee36.pdf
- Mauritius Telecom (2021). Enriching connectivity through Enhanced ICT Services, IPTV, Superfast Broadband & Cable partnerships. <https://www.telecom.mu/aboutus/our-network/>
- Midgley, G and Lindhult, E. (2017). What is systemic innovation? *Research memorandum*, University of Hull.
- Ming-Chin, C. and Gupta, S. (2017). The incentive effects of R&D tax credits: An empirical examination in an emerging economy, *Journal of Contemporary Accounting & Economics*, 13(1), 52-68.
- Ministry of Business, Enterprise and Cooperatives 2017. 10 - Year Master Plan For The SME Sector in Mauritius. https://enterbusiness.govmu.org/SiteAssets/MofedStyles/Documents/SME%20Master%20Plan_Full%20Version_FINAL.pdf
- Ministry of Education, Tertiary Education, Science and Technology (2020). Major achievements 2020. <https://education.govmu.org/Documents/Major%20Achievements/Major%20Achievements%202020.pdf>
- Ministry of Education, Tertiary Education, Science and Technology (2021). Secondary Education. <https://education.govmu.org/Pages/Education%20Sectors/Secondary%20Education/Secondary-Education-.aspx> .
- Ministry of Finance and Economic Development (2017). Budget Speech 2017-2018- Rising to the Challenges of our ambitions. https://mof.govmu.org/Documents/Documents/Budget%202017-2018/Budget2017-2018/2017_18budgetspeech.pdf
- Ministry of Finance, Economic Planning and Development (2021). Budget Speech 2020/2021- A Land of Achievers and of Achievements. https://budgetmof.govmu.org/Documents/2021_22budgetspeech_english.pdf
- Ministry of Industrial Development, SMEs and Cooperatives and United Nations Conference on Trade and Development (2020). Industrial Policy and Strategic Plan for Mauritius 2020-2025. https://unctad.org/system/files/official-document/gdsinf2020d5_en.pdf

- Ministry of Technology, Innovation and Communication (2018). *National Innovation Framework 2018-2030*, http://www.mric.mu/English/Documents/Booklet_NIF.pdf
- Ministry of Technology, Innovation and Communication (2018). *National Innovation Framework 2018-2030*. http://www.mric.mu/English/Documents/Booklet_NIF.pdf
- Nieto, M.J. and Santamaría, L. (2007). The importance of diverse collaborative networks for the novelty of product innovation. *Technovation*, 27 (6–7), 367-377.
- Nishimura, J. and Okamuro, H. (2011). Subsidy and networking: The effects of direct and indirect support programs of the cluster policy. *Research Policy*, 40 (5), 714- 727.
- Organisation for Economic Co-operation and Development (OECD), 1997. National Innovation Systems. <https://www.oecd.org/science/inno/2101733.pdf>
- OECD (2017). Schools at the Crossroads of Innovation in Cities and Regions, *Centre for Educational Research and Innovation*, https://www.oecd-ilibrary.org/education/schools-at-the-crossroads-of-innovation-in-cities-and-regions_9789264282766-en
- Roopchand, R. (2020). Analysing the different Entrepreneurship Education initiatives for the development of a conducive and motivating entrepreneurial ecosystem in Mauritius. *Management and Entrepreneurship Trends of Development*, 3(13), 97-113.
- Sadraoui, T. and Zina, N. B. (2009). A Dynamic Panel Data Analysis for R&D Cooperation and Economic Growth. *International Journal of Foresight and Innovation Policy*, 5(4), 218-233.
- Saguy, S. (2011). Academia-industry Innovation Interaction: Paradigm Shifts and Avenues for the Future. *Procedia Food Science*, (1), 1875 – 1882.
- Schacht, Wendy H. (2010). Cooperative R&D: Federal Efforts to Promote Industrial Competitiveness. *Library of Congress Washington DC Congressional Research Service*.
- Schroth, F. and Jakob Häußermann, J. (2018). Collaboration Strategies in Innovation Ecosystems: An Empirical Study of the German Microelectronics and Photonics Industries. *Technology Innovation Management Review*, 8(11), 4-12.
- Still, K., Huhtamäki, J., Russell, M.G., Rubens, N. (2014) Insights for orchestrating innovation ecosystems: the case of EIT ICT Labs and data-driven network visualisations. *International Journal of Technology and Management*, 66 (2/3), 243-265.
- Suurs, R.D. and Elsbeth Roelofs, Ir. (2014). Systemic Innovation: Concepts and tools for strengthening National and European eco-policies. https://www.tno.nl/media/3388/systemic_innovation_eco_policies_tno_2014_r10903.pdf
- The Mauritius Emerging Technologies Council Bill (2021). <https://mauritiusassembly.govmu.org/Documents/Bills/intro/2021/bill0821.pdf>
- The World Bank Group (2016). Measuring Regulatory Quality and Efficiency. *Doing Business*. <https://www.doingbusiness.org/content/dam/doingBusiness/media/Annual-Reports/English/DB16-Full-Report.pdf>
- The World Bank Group (2017). Equal opportunity for all. *Doing Business*. <https://openknowledge.worldbank.org/bitstream/handle/10986/25576/109914-WP-DB17-PUBLIC-Mauritius.pdf?sequence=1&isAllowed=y>
- The World Bank Group (2018). Reforming to Create jobs. *Doing Business*. <https://documents1.worldbank.org/curated/en/428061510050716525/pdf/WP-PUBLIC-DB18-MUS.pdf>

- The World Bank Group (2019). Training for Reform. *Doing Business*. https://www.doingbusiness.org/content/dam/doingBusiness/media/Annual-Reports/English/DB_2019-report_web-version.pdf
- The World Bank Group (2020). Comparing Business Regulation in 190 economies. *DoingBusiness*. <https://www.doingbusiness.org/content/dam/doingBusiness/country/m/mauritius/MUS.pdf>
- Tim, S. (2021). Number of regulatory sandbox licenses granted by Mauritius body to fintechs grows to nine. *Ventureburn*. <https://ventureburn.com/2019/08/edb-mauritius-nine-regulatory-sandbox-licenses-granted/>
- Tsai, K.H. (2009). Collaborative networks and product innovation performance: toward a contingency perspective. *Research Policy*, 38 (5), 765-778.
- United Nations General Assembly 2016. Entrepreneurship for development. https://unctad.org/system/files/official-document/a71d210_en.pdf
- University of Mauritius (2020). A Key driver of Innovation. *Innovation Week 2020 Government -Academia-Industry Partnership*. <https://sites.uom.ac.mu/innovation-week/images/files/2020/InnovWeekProg2020.pdf>
- Wakellin, K. (2001). Productivity Growth and R&D Expenditure in UK. Manufacturing Firms. *Research Policy*, 30(7), 1079-1090.
- Whicher, A. (2021) Evolution of policy labs and use of design for policy in UK government, *Policy Design and Practice*, 4(2), 252-270.