Values-Based Development and Competitiveness: A Conceptual Analysis

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VALUES-BASED DEVELOPMENT AND COMPETITIVENESS: A CONCEPTUAL ANALYSIS

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ABSTRACT:

The global economic landscape is undergoing rapid transformation powered by science, technology and innovation (STI). Countries and communities that invest in developing a holistic and dynamic STI ecosystem are in a better position to derive greater Return on Value (ROV) for their stakeholders and mitigate external shocks to their economies. One of the major challenges faced by developing countries is to ensure STI policies and strategies are congruent to their socioeconomic aspirations and development. In this study, we propose a new values-based sustainable ecosystem development framework, which incorporates the United Nations Sustainable Development Goals (UN-SDGs) and the global STI drivers to deepen the socioeconomic drivers of countries and communities. The study also provides a detailed characterisation of the enablers of Science, Technology, Innovation and Economy (STIE) ecosystem and mechanisms for economic agents to move-up the global STI and economic value chain. The framework also provides insights on how they can nurture network externalities and multiplier impact, all of which are critical for economic agents to "leap-frog" to higher stages of development aligned to the UN-SDGs.

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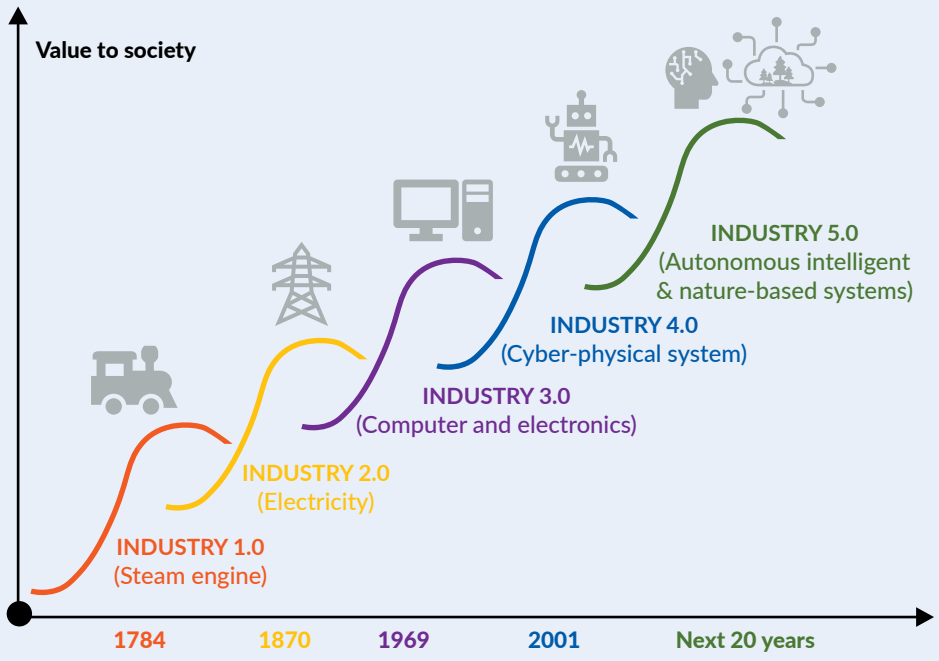
TABLE OF CONTENT

01 | INTRODUCTION

The global economy has seen an unprecedented economic transformation over the last 300 years, powered by science, technology and innovation (STI). These transformations can be mapped into five waves of STI development: Industrial Revolution 1—1784 to 1840, the steam engine revolution; Industrial Revolution 2—late 19th century to early 20th century, massive electrification; Industrial Revolution 3—1960s to 1990s, the electronics, computer and internet revolution; and Industrial Revolution 4—beginning of the 21st century, involving the integration of the cyber and physical world and leading to the internet of things, artificial intelligence (AI), machine and deep learning tools, smart devices, robotics, and autonomous vehicles and machines (Schwab, 2017). While many countries are undergoing Industrial Revolution 4, or 'Industry 4.0', more advanced countries are already powering the next phase of the industrial revolution. That is, they are in the early phase of Industrial Revolution 5, in which there is greater integration of AI systems with human intelligence systems, enabled by high-speed computing (quantum computing). These advances have allowed the use of human-based principles to address grand challenges impacting society (Maddikunta et al., 2021). Closer integration of human and AI systems has opened up the opportunity of humanising STIs to meet the sustainable development needs of all segments of society. A summary of the structural changes powered by STIs is shown in Figure 1.

Figure 1: Structural Transformation in the STI Landscape from 1700 to 2040



Historical scrutiny shows that the industrial revolution waves fostered an increasing convergence between technological, economic, social, environmental, and political systems (Maynard, 2015). These transformations were part of the stimulus to major structural changes in many economies, enabling them to transition from agrarian-based economies to production-based economies (Academy of Sciences Malaysia, 2021, 2020). As these economies adopted new technologies, there was an expansion in factories capable of producing products and services in volume, at higher quality and faster speed. In many of these economies, the manufacturing sector became a major contributor to economic development. With the emergence of the information revolution, many production based economies invested in information and communications technology (ICT) infrastructure and talent. Over time, these countries also invested in digital technologies, and with concerted effort, they were able to capture network externalities, allowing them to gain both economies of scale and scope. For many economies, the use of ICT was an important source of efficiency, productivity and market reach (Nair & Shariffadeen, 2009; Kayisire & Wei, 2016; Okundaye et al., 2019; Nair et al., 2020; Pradhan et al., 2021).

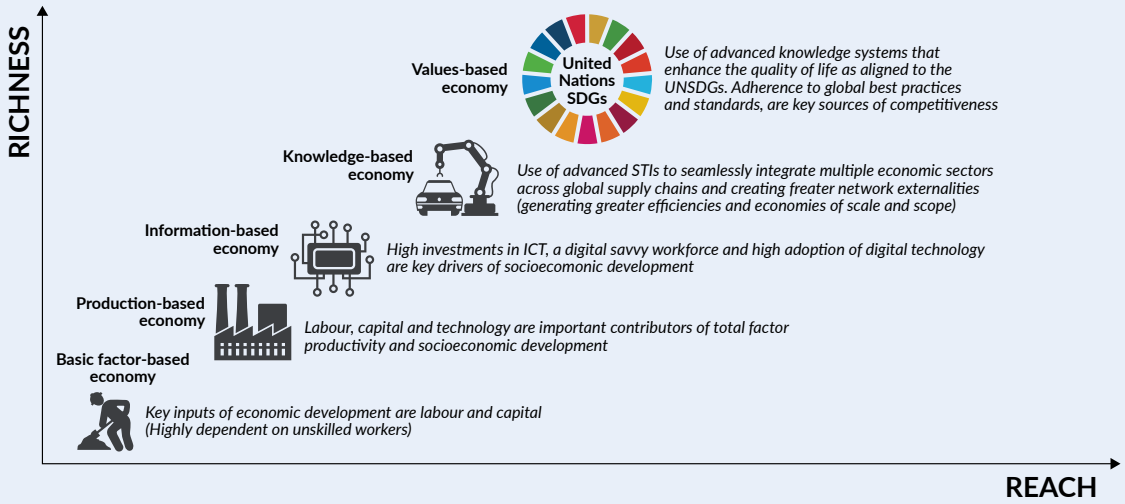
Digitisation of economies spurred major STI advances, often leading to positive spill-overs into other areas, leading to convergence across diverse technologies. Converging technology platforms, especially digital, social, financial, and other physical systems, enabled the emergence of next-generation technologies. Emerging new technologies facilitated seamless integration of information, allowing for improved strategic decision-making by the various economic agents. All of which, powered the emergence of knowledge-based systems. Taken together, these systems allow access to real-time market intelligence for policymakers, corporate players, community organisations, and other stakeholders to design and develop effective strategies. The emergence of next-generation STIs and knowledge systems has also opened up a wealth of opportunities. For instance, using big-data systems allows institutions to access information from a wider network of stakeholders and thereby enable evidence-based decision-making. The positive spill-over impact of STIs on society has led to significant improvement in economic prosperity, disposable income levels and employment opportunities. Adoption of emergent STIs has helped people access quality education, health care and other public and welfare services.

While STIs have led to several positive impacts on humanity, STI use has also allowed unfettered development, resulting in several negative externalities. These include environmental degradation, natural habitat loss and natural biodiversity decline, which have all contributed to global warming and reduction in the quality of life (Whitmee et al., 2015; Otero et al., 2020; Dasgupta, 2021). Differential access to STIs has contributed to increasing knowledge and wealth gaps between the 'haves' and 'have-nots' (Nair, 2011; Academy of Sciences Malaysia, 2020; Pi & Zhang, 2018; United Nations ESCAP, 2018; Mirza et al., 2019). The widening gap has adversely affected the quality of life of citizens across the globe, especially marginalised and vulnerable groups. Indigenous communities are the group most affected by climate change and environment-unfriendly activities.

There is widespread consensus that STI development should assist countries to improve the quality of life of all citizens, as outlined in the United Nations 17 Sustainable Development Goals (UN-SDGs). In recent times, the increasing awareness of the UN-SDGs is driving a shift in mindset across many developed and developing countries towards values-based economic development, one that is anchored by the UN-SDGs. To this end, many countries have put sustainable development, human rights, environmental and climate-change issues at the core of their development agenda. Increasingly, these issues are being incorporated into global economic and trade regulations and treaties, and many developed countries are imposing these standards on products

and services by levying taxes and tariffs on products that do not meet the standards. Such measures have major ramifications for countries, especially those from the developing world. A summary of the structural changes that have taken place and are continuing to shape socioeconomic development is presented in

Figure 2: Structural Changes in the Global Economy



Note: Reach is the ability to impact a wide spectrum of stakeholders. Richness is improving the quality of the STI, in deepening the impact on productivity, efficiency, competitiveness and economic development.

Figure 2.

This paper puts forward a new values-based development framework that enables resources to be harnessed for countries, organisations and communities to move up the global value chain. The framework is based on an ecosystem approach, in which key ecosystem enablers nurture strong collaborative engagement to create return on value (ROV)[2] for all stakeholders in the economy or community.

This paper is organised as follows. In Section 2, an ecosystem model is presented. Here, the philosophy of sustainable development and ecosystem enablers that ensure the practice is aligned with the UN-SDGs is presented. The ecosystem ensures the development of strong dynamic capabilities (absorptive, adaptive and innovative) of all stakeholders in the economy. In Section 3, an impact model showing the link between ecosystem enablers, dynamic capabilities and sustainable development is detailed. Sustainable development covers economic, social, political and environmental development. The model draws out the network externalities and spill-over impact that can be derived from an integrated science, technology, innovation and economy (STIE) ecosystem framework. Section 4 highlights the link between the state of the STIE ecosystem and movement up the global innovation value chain, including the possibility of leap-frogging stages of development. In Section 5, key lessons are teased out to highlight the steps needed to develop a robust, agile, dynamic and values-driven STIE ecosystem.

[2] ROV is characterised as value-creation opportunities and benefits from the use of STI and knowledge-based systems. A more detailed description is provided in Section 2 of the paper.

02 | VALUES-BASED DEVELOPMENT: 8R-8i STIE ECOSYSTEM FRAMEWORK

Over the past 300 years, the global economic landscape has evolved because of advancement in STI, leading to the convergence of multiple domains and platforms covering technology, social, economic, political and environmental spheres. A hyperconverged global society has created multiple positive spill-over impacts on society. Among these is freer and wider access to information and knowledge, as well as increasing economic trade and wealth across the globe. The downside to a hyperconverged global society is the negative spill-over impacts, such as environmental degradation, transboundary pollution, economic volatility, social instability and the rapid spread of health pandemics.

The magnification of negative externalities arising from greater integration of the global community is necessitating a rethink of the development model. There is a need to develop a new architecture anchored in values that ensure greater care for the environment, justice, equality and equity for all people irrespective of their background and social circumstances. The new development model must ensure that people from different walks of life have opportunities to gain access to key resources to improve their quality of life. In particular, the new development model must ensure that the economic, social and political empowerment of people and environmental imperatives are given equal prominence in the development agenda. In the discussion that follows, we propose a new values-based STIE development framework that enables communities and countries to progress by adopting more sustainable development trajectories.

2.1 Characterisation of Return on Value (ROV)

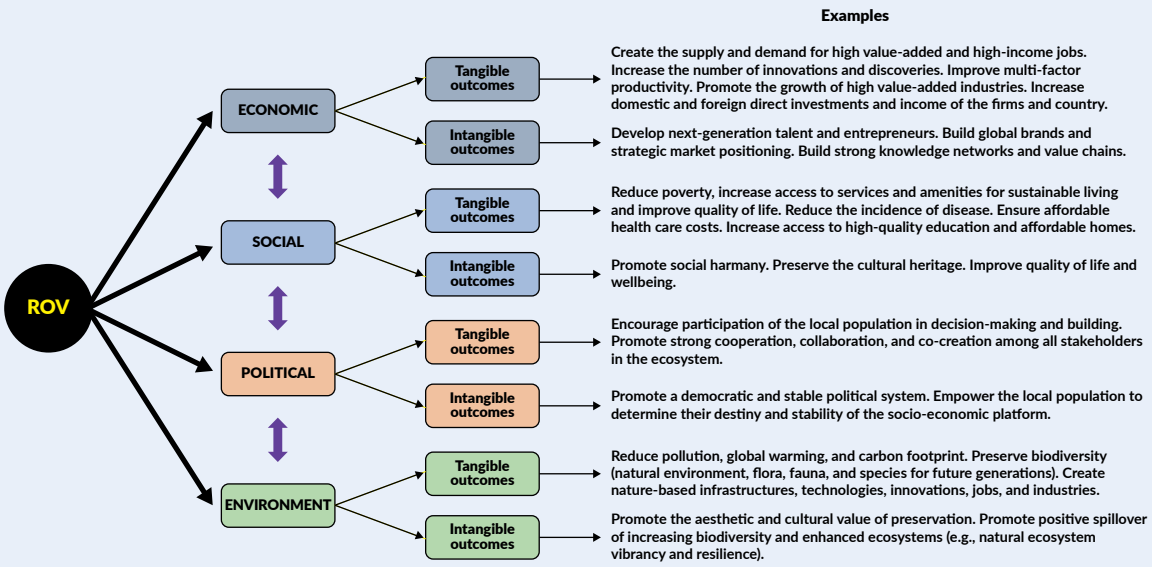
The notion of 'return on investment' (ROI) is well entrenched in the development agenda. However, the concept of 'return on value' (ROV) is not widely known or used by policymakers, industry and other stakeholders. Here, we characterise ROV as the value gained to all stakeholders (from economic, social, political, and environmental perspectives) resulting from the adoption of STIE and knowledge-based systems, processes, new business models and value chains that are aligned to global best practices. In terms of these four perspectives, the value creation is:

- **economic** — to generate new innovations, discoveries and knowledge that contribute to: creative talent, entrepreneurial acumen and transformative leaders; process improvement, improved design and product development; increase local industry and workforce competitiveness; and the creation of new knowledge-intensive industries, development of global brands, positional innovation, jobs and other economic wealth-creation opportunities.

- **social** — a reduction in poverty, crime and social problems; an increase in literacy rates, including digital literacy; higher education attainment and competencies for a modern economy; improved access to health care and other public facilities and amenities; improvement in the population's lifespan and quality of life; and nurturing of social harmony and preservation of the local way of life and cultural heritage. Doing so involves fostering stronger collaboration, cooperation and co-creation among all segments of the population to create dynamic and vibrant ecosystems.
- **political** — empowerment of the local community and ensuring democratic reforms are in place to enable the local population to play an active role in developing their communities and localities; and, providing greater voice and accountability to the local population in the decision-making that affects them. All these contribute to the social harmony and stability of social and political systems.
- **environment** — ensuring the adoption/use of best environmental management practices and biodiversity conservation efforts to mitigate the risks associated with climate change, pollution, biodiversity loss and the extinction of endangered species. These serve to increase the aesthetic value of the natural environment for society and future generations.

The ROV for the four dimensions has both tangible and intangible impacts on key stakeholders in the ecosystem. Tangible impacts can be measured relatively more easily and have clearly specified outcomes. In contrast, intangible impacts may not lead to immediate measurable outcomes, but over time their existence can lead to measurable outcomes. Further, there are strong endogenous relationships between the four ROV dimensions. For example, a well-managed environment can lead to eco-friendly industries, thereby contributing to economic outcomes. Similarly, strong empowerment of local communities can lead to greater social harmony. Examples of tangible and intangible outcomes for the four dimensions and the dynamics between them are given in Figure 3. Note that investments in creating the ROV translate into greater ROI for the ecosystem over time. Hence, the ROI can be specified as a function of the ROV.

Figure 3: Return on Value (ROV) for a Values-Based Development Model



Note: ROV refers to return on value, which is characterised as value-creation opportunities and benefits from the use of STI and knowledge-based systems.

2.2 Values-Based Development Philosophy

It is widely accepted that while STIs have led to several benefits for humanity over the last 300 years, they have also led to major negative externalities for the global community. These include climate change, environmental degradation, biodiversity loss, increasing zoonotic diseases, widening knowledge and wealth gaps among the 'haves' and "have-nots", poverty, violation of human and animal rights and other negative market externalities.

The philosopher, Seyyed Hossein Nasr contends that 'although science is legitimate in itself, the role and function of science and its application have become illegitimate and even dangerous because lack of a higher form of knowledge into which science could be integrated and the destruction of the sacred and spiritual value of nature' (Nasr, 1997, p.14). He emphasises that 'the destruction of the equilibrium between man and nature' is a result of humankind's 'further conquest and dominion of nature' (Nasr, 1997, p.13). He states that the challenges of society today can be traced back to the development model that is centered on the 'dominion of nature' (Nasr, 1997).

In this context, humanity's sustainable development is only possible if there is a deeper understanding of the symbiotic relationship between man and nature. Hence, to overcome the current challenges, 'the metaphysical knowledge pertaining to nature must be revived and the sacred quality of nature given back to it once again' (Nasr, 1997, p.14). This includes transitioning from the traditional development model of extracting the maximising profits/returns for corporate shareholders to a more values-based development model that is explicitly designed to drive greater ROV for nature and all stakeholders in the ecosystem. When nature is vibrant and healthy, it has a similar spill-over on all human existence and activities. Drawing on this context, we propose a framework that incorporates the UN-SDGs as core to all development agenda.

While the UN-SDGs have been important to galvanise the global community towards sustainable socioeconomic trajectories, the outcomes, in many countries, with respect to achievement of the development goals have been mixed to date.[3] To gain greater traction in achieving the UN-SDG targets, a change in mindset is needed among all stakeholders (policymakers, citizens, corporations, community organisations and others) in inculcating the spiritual connection with nature and everything therein. Human society's sustainable development can only occur if core values shift from 'man's dominion of nature' to 'mankind's stewardship' of nature for creating better value for current and future generations. This will instil greater respect and reverence for nature and its resources to support a more humane, equitable and just development agenda. In this context, we propose eight core values (the '8Rs')[4] be incorporated into all development initiatives to obtain higher value from natural resources[5] within the ecosystem (as shown in Figure 4) —respect, rethink, reduce, reuse, recycle, restore, repurpose and revitalise—summarised following:

- **respect** for human rights, animal rights, biodiversity and health of the planet.
- **rethink** the use of ecosystem resources, with strategies put in place to obtain the best ROV from these resources to benefit society and its future generations.
- **reduction** of human activities and unfettered consumption that adversely affect the quality of the resources in the ecosystem, human life, societal development and the environment.

[3] The Sustainable Development Report 2022 Dashboards show that very few countries are achieving or are on track to achieving the UN-SDG targets. Most of the countries are high-income and Organisation for Economic Co-operation and Development (OECD) countries. Most developing and under-developed countries are not achieving or falling behind in achieving the UN-SDG targets. Refer to Sachs et al. (2022).

[4] This philosophy was adapted from Sibaud and Gaia Foundation (2013), but modified by the authors for a values based development framework, aligned to the UN-SDGs.

[5] The resources are land (including natural resources and the environment), labour (talent) and capital (financial assets) of a country.

- **reuse** of ecosystem resources effectively and in multiple ways to reduce wastage and enhance responsible consumption (reduce unfettered demand for resources).
- **recycling** of unwanted waste to ensure existing resources in the ecosystem are used optimally, creation of new value from waste and ensuring current resources are preserved for future generations – promoting "circular economic and development" models.
- **restoration** of the value of the resources in the ecosystem by using them effectively and continuously investing appropriate STIs to create new value to improve the quality of these assets and quality of life for all stakeholders.
- **repurposing** (reconfiguring) of the resources in the ecosystem for multiple uses to create multiplier effects and enable economies of scale and scope, in the process create higher ROV for all stakeholders.
- **revitalisation** of the value of the resources in nature by continuously investing in them, preserving and harnessing their full potential and value for current and future generations.

Figure 4: 8R Values-Based Development Philosophy

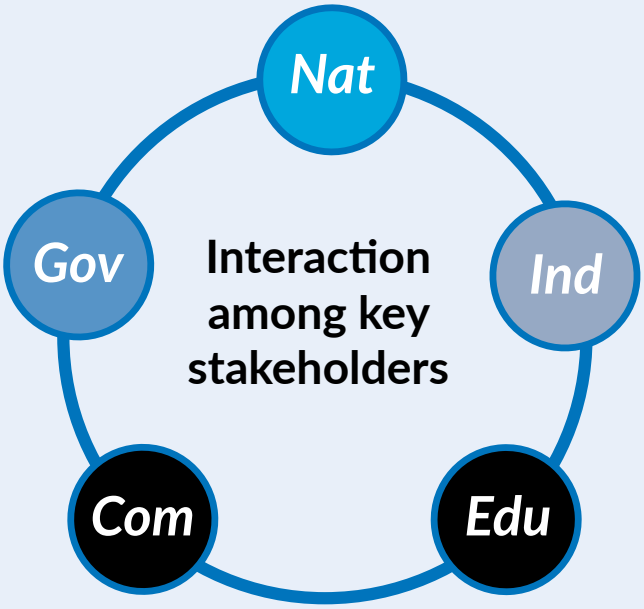
The 8R Philosophy involves a mindset change to develop a more progressive, humane, caring and environmentally friendly society. It is crucial that this mindset is encapsulated within the UN-SDGs to:

- break the vicious cycle of poverty and empower vulnerable communities to improve their quality of life by giving them access to necessary resources and life skills;
- address inequality and inequities that perpetuate and widen knowledge and wealth gaps between the 'haves' and 'have-nots' by providing access to vital services that can improve the quality of life of all segments of the population;
- invest in infrastructure development, education, industrial development and innovation to enhance the competitiveness of environmentally-friendly local industries and create sustainable employment opportunities for all segments of the population;
- ensure the sustainability of communities and cities by adhering to global best practices and standards relating to the environment, planetary health and climate change;
- develop strong institutional leadership and institutions to ensure good governance, peace, prosperity, security and justice for all communities and countries; and,
- build strong partnerships and networks to nurture progressive societies and a humane development agenda anchored on sustainable social inclusion, political empowerment, economic prosperity, good environmental management practices and the preservation of biodiversity and conservation of our natural habitat and the species therein.

2.3 Network Externalities—Collaboration and Co-Creation

To ensure that the 8R Philosophy is incorporated into the development agenda, there is a need to foster strong cooperation and collaboration among key stakeholders in the economy ("quintuple helix" - nature (Nat), industry (Ind), educational institutions (Edu), community organisation/civil society (Com) and government agencies (Gov), as shown in Figure 5.

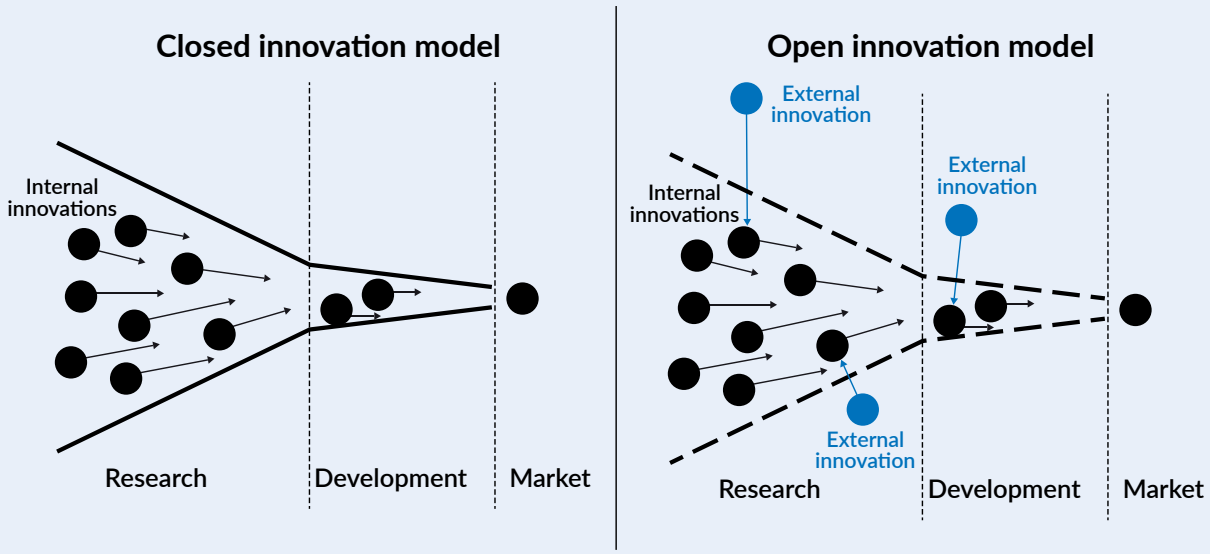
Figure 5: Quintuple Helix to Support the 8R Philosophy



A key feature of a collaboration ecosystem is the transition from a closed science, technology, innovation and economic (STIE) model, in which there is very little sharing of information and knowledge across players in the ecosystem, to a more open STIE model.[6] In the closed STIE model, key players in the ecosystem undertake their own innovations with very little sharing of information or knowledge with external institutions and economic agents. This leads to several market failures, including: intensifying competition among key players for resources that are scarce; resource duplication; incomplete innovations; the slowing down of speed to market; and, the failure of products and services in meeting market needs. These all lead to the inefficient use of scarce resources; stifling of network externalities and productivity; increase cost of research and development (R&D), innovation, and products and services; limiting of the quantum and quality of the innovations; and hindering of local supply chains' development and competitiveness.

In contrast, open innovation models tend to have more 'porous' STIE ecosystems that enable key players to share information and knowledge to cross-pollinate their own ecosystems with new ideas and innovations. These are undertaken via various mechanisms such as joint-venture arrangements, joint projects and grants, the sharing of expertise and the co-funding of research infrastructure, among other collaborative arrangements. Collaborative arrangements enable organisations to reduce their R&D and innovation costs, increase the market potential of their innovation and strengthen the entire STIE value chain. Most economic agents invest in their core competencies to create value for themselves and other stakeholders and avoid spreading themselves thinly. These mechanisms enable the production of goods and services that meet the needs of the market. The closed and open innovation models are shown in Figure 6.

Figure 6: Closed Versus Open Innovation Models

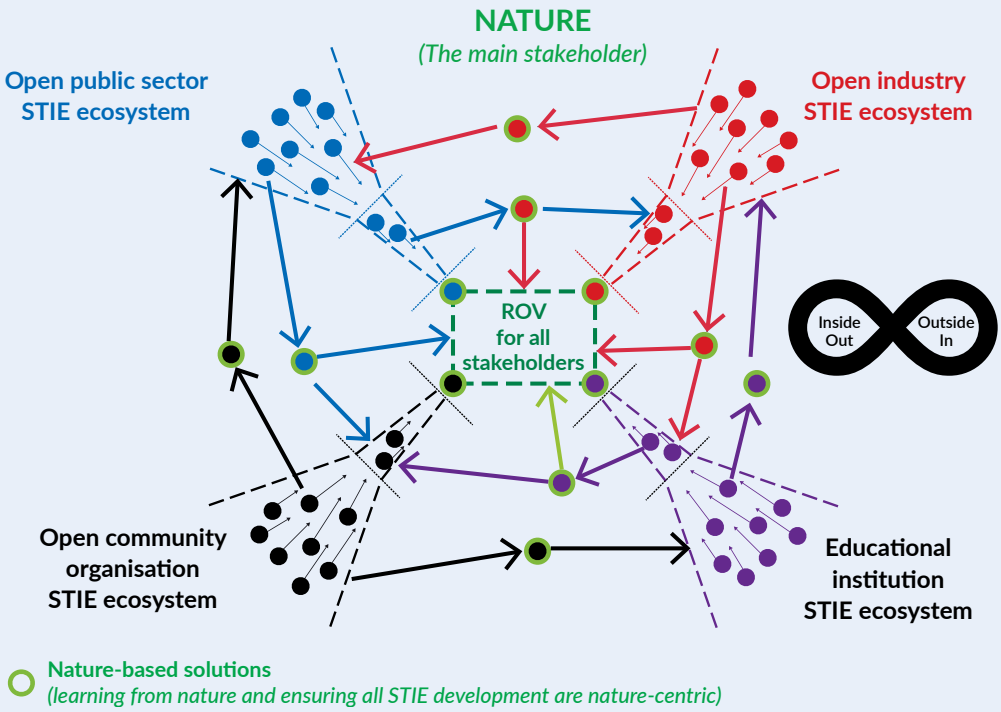


Source: Chesbrough (2009)

[6] The open and closed innovation models were characterised by Chesbrough (2009). We have adapted them in the context of the STIE ecosystem model.

An example of an open STIE model that incorporates five stakeholders is shown in Figure 7. In this ecosystem, there is potential for the public sector, industry, community organisations and educational institutions to not only share information and knowledge among themselves but also adopt and adapt knowledge from nature to create new nature-based products and services. This new open STIE model is an 'inside-outside and outside-inside' model, where all stakeholders create innovations that are useful to others outside the ecosystem. At the same time, key players also improve their ideas, innovations, products and services from the knowledge obtained from stakeholders outside the ecosystem. The strong symbiotic relationships between the five stakeholders serve to deepen the reach and richness of their own ecosystems. We call this inside-out, outside-in reinforcement process, the INFINITY STIE Loop model (as shown in Figure 7).

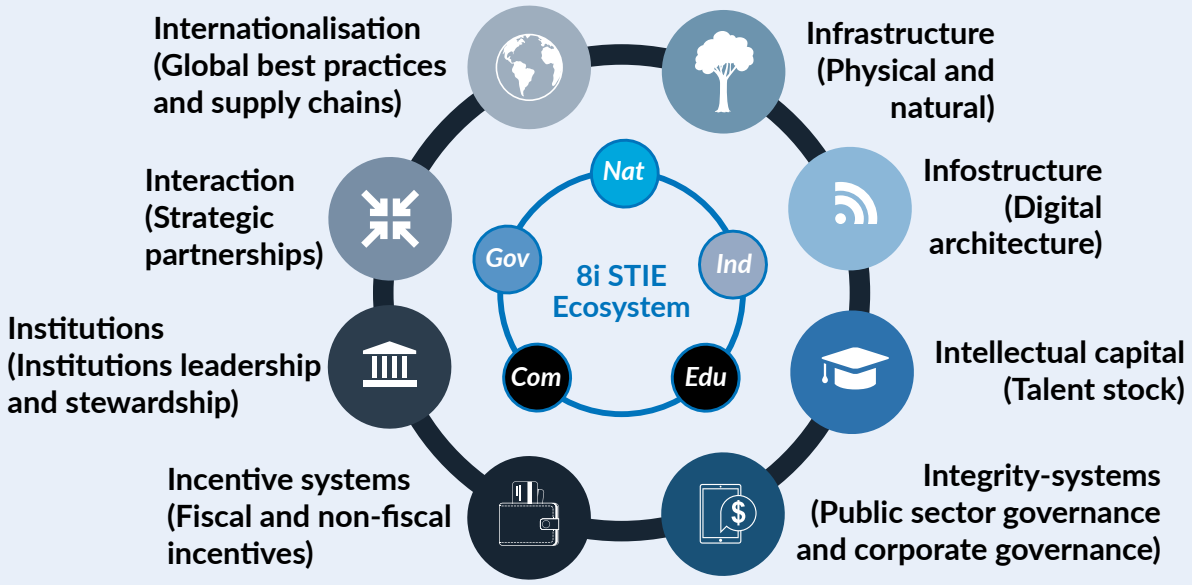
Figure 7: The Inside-outside and Outside-inside STIE Ecosystem Model
(Infinity STIE Loop Model)



2.4 Characterisation of the STIE Ecosystem

To enable the above-mentioned collaborative networks, an ecosystem approach is needed to ensure that the multi-stakeholder partnerships build strong trust among all players. Trust is critical for a sustainable STIE ecosystem; and sustained innovation and development. In this paper, the enablers of the STIE ecosystem are characterised by the 8i Ecosystem framework (Figure 8), and each enabler is discussed below.:

Figure 8: 8i STIE Ecosystem Model



Note: The notations 'Nat', 'Ind', 'Edu', 'Com' and 'Gov' are the multiple stakeholders in the ecosystem, namely nature, industry, educational institutions, community organisations/civil society organisation and government agencies, respectively

- **Infrastructure** (natural and physical infrastructure): Quality of the natural infrastructure (the environment) and physical infrastructure (roads, ports, etc.), such that it embeds the 8R Philosophy in all its decision-making, planning and development phases. This includes the use of advanced technology to ensure development activities adhere to global best practices pertaining to human and animal rights, biodiversity conservation, socioeconomic development and environmental management. Integration of the STI strategy and socioeconomic drivers is outlined in Section 2.6.
- **Infostructure** (digital architecture): ICT connectivity and the use of advanced digital technology (such as big data, blockchain technology, AI systems and other digital technologies) to enable seamless integration of multiple digital and data analytic systems to capture real-time information for strategic decision-making, while ensuring the uses are aligned to the 8R Philosophy. This requires monitoring and tracking of policies and strategies, and efficacy of policies, strategies and programmes, including supporting open science, data and research platforms.
- **Intellectual capital** (talent stock): Enculturation of the 8R Philosophy at all levels through community engagement and public awareness programmes. This requires ensuring an adequate number of people possess the necessary specialised knowledge and technical, entrepreneurial and leadership skills to create and adopt new STIs, knowledge systems and innovations aligned to the 8R Philosophy and shape behaviour according to its principles. This will help increase the supply and demand of creative talent, STIs, nature-based products and services.
- **Integrity systems** (public and corporate governance systems): Governance systems that ensure adherence to global best practices related to the 8R Philosophy. These include having appropriate regulations, incentives, business-friendly policies, monitoring and tracking mechanisms and best practices for the sustainable use and development of natural assets in the ecosystem to increase the ROV for all stakeholders and the economy at present and in the future.
- **Incentive systems** (fiscal and non-fiscal incentives): Introduction of comprehensive economic and financial incentives that encourage the development and adoption of new STIEs models and frameworks, aligned to the 8R Philosophy. These require using incentives to drive and support the following activities:
    - strengthening the "quintuple helix"—support for the creation of a vibrant collaborative platforms and knowledge-sharing culture among all stakeholders in the ecosystem;
    - increasing domestic and foreign investments to nurture strong local STI players, knowledge networks and sustainable supply chains;
    - removing subsidies for activities that adversely affect the environment and violate human & animal rights; and other initiatives that detract from the UN-SDG outcomes;
    - levying taxes on initiatives that hinder the UN-SDG initiatives and providing subsidies for STIE initiatives that contribute to meeting the UN-SDG outcomes and targets;
    - exploring the introduction of an R&D CESS fund and innovation sovereign funds to support the STIE initiatives that contribute to the long-term development of a vibrant national innovation ecosystem and sustainable socioeconomic development; and,
    - providing direct incentives to make national research facilities (in public universities, research and testing centres) available for industry, especially small and medium enterprises and start-up firms.

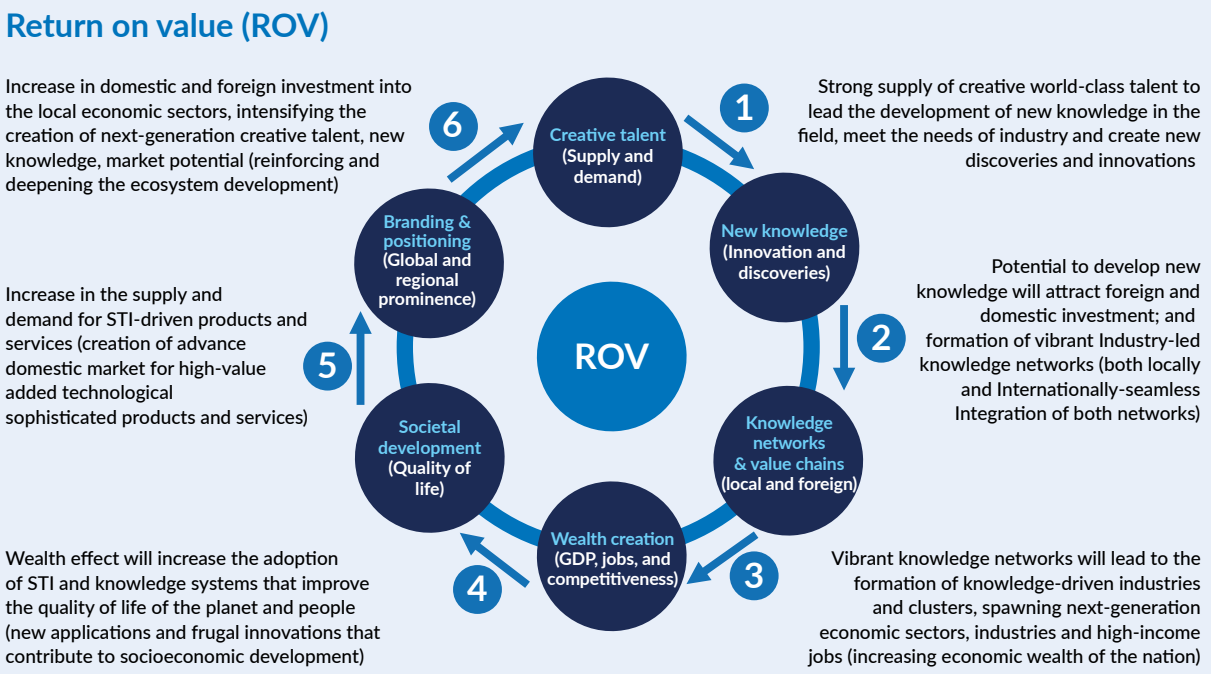
- **Institutions** (institution leadership and stewardship): Quality of institutions of governance at all levels of government (federal, state and local council), industry, community/civil society and educational institutions in managing and harnessing the socioeconomic activities and aligning them to the 8R Philosophy – taking a "Whole of Government and Whole of Society" approach in managing the assets of the country more effectively. This requires having adequate 'champions with clout' who can lead the socioeconomic and environmental development agenda and align them to the 8R Philosophy across all levels of government, economic sector and locality (rural and urban). Institutions should strive to achieve greater ROV for all segments of the population and the nation. To achieve ROV, there is a need to select the best leadership team and diverse board members that incorporate ROV-driven performance indicators to nurture a high-performance culture.
- **Interaction** (strategic partnerships and collaborative networks—inside-out and outside-in model): Mechanisms and incentives are in place to enhance trust among all players in the ecosystem. Without trust among key stakeholders, fostering a knowledge-sharing culture will be difficult. Intensifying the depth and quality of cooperation, collaboration, co-creation and knowledge sharing between stakeholders create network externalities and multiplier effects for all players in the ecosystem. A key incentive that fosters strong partnerships among players is policy consistency and commitment by the government to invest jointly with the private sector in high-end national STI infrastructure and talent. Other incentives include developing business-friendly policies, favorable taxation systems and other sound macroeconomic policies. Furthermore, in many high-tech nations, such as Korea, Taiwan and China, the government is the largest user of locally developed innovations, products and services. This enables the local industry to develop a strong local supply chain and enhance its regional and global competitiveness.
- **Internationalisation** (global outreach, networks and standards): Clear policies and strategies should be devised to help local firms and players penetrate global markets. In this context, mechanisms need to be in place to gather market intelligence from global markets, coupled with strategic partnerships with leading international players to foster technology and knowledge transfer. Key among these is the need to understand trade policies and regulations of these markets and develop local knowledge networks and supply chains that meet global standards and best practices.

Clearly articulating the ROV of all institutions and organisations in the ecosystem is required, as outlined below (also refer to Figure 9). Institutions and organisations should:

- nurture creative talent that meets the needs of society and industry;
- generate new knowledge (innovation and discoveries);
- establish sound knowledge networks and build strong sustainable value chains;
- put in place strategies to create new jobs, enhance competitiveness and increase the wealth of the country;
- strengthen the health of the planet, people and the economy in order to nurture continuous societal transformation, such that it delivers a higher quality of life and conserves nature for long-run sustainable development – meet the needs of the people and economy at present and in the future; and,
- position and brand the institutions, industry and nation as regional and global centres of STIE excellence in key strategic areas that will contribute to regional and global socioeconomic development.

To enhance the ROV continuously, mechanisms must be in place to undertake regular STIE fore-sighting and market intelligence on structural changes taking place within the global economy. Organisational governance can be enhanced through the incorporation of ROV–key performance indicators (KPIs) for employees of organisations, community and country; and these are to be tracked, monitored and reported on a regular basis.

Figure 9: Institutional and Organisational Return on Value (ROV) to Society



Note: STI refers to science, technology and innovation.

2.5 Dynamic Capabilities

A strong ecosystem is critical for building the dynamic capabilities of organisations and industry players. 'Dynamic capability' is defined as how well an organisation or firm can systemically mobilise and allocate resources within and external to the organisation to build strong absorptive, adaptive and innovative capabilities:

- Absorptive capability—the ability of economic agents to recognise the importance of new and external information and have adequate internal organisation structures to adopt and be adept in the use of the new knowledge to create better ROV for the organisation and others. This includes undertaking the following activities:
    - regularly scanning the external environment for new user insights, market intelligence and opportunities;
    - obtaining STIs from external sources;
    - undertaking various capability development programmes to transfer new knowledge to the organisation;
    - systematically acquiring and storing vital knowledge for future use; and,
    - obtaining knowledge and disseminating that knowledge across the organisation.
- Adaptive capability—the ability of economic agents to respond to the external environment and market conditions by allocating resources to reconfigure production processes, products, services, capabilities and business models to meet market and societal needs. Among the activities classified as adaptive capabilities are:
    - continuous investment to improve the current knowledge base;
    - the ability to respond to the external environment and new opportunities that become available to the organisation; and
    - investment in developing internal organisation structures and processes that can respond to changes taking place in the external environment.
- Innovative capability—the ability of the economic agents to develop new solutions, products, services, methods of production, markets and business models, especially through the use of STIs. Among the activities classified as innovative capability are:
    - discoveries of novel ideas and new breakthroughs in STIs and/or business models that deliver significant ROV for the organisation and other users of the innovations; and,
    - development of new and novel STIs that make significant improvements to current practices, process improvement and product development.

Dynamic capabilities are spread across a continuum from the absorptive capability to adaptive capability, and, finally, to innovative capability, as shown in Figure 10. Strong absorptive capabilities with sound 8R-8i STIE Ecosystem will result in building adaptive capability, and ultimately lead to the nurturance of innovative capability. Through this process, organisations borrow STIs from the external environment and then slowly embed them into their own corporate strategy and operations. This requires them to modify and adapt external STIs to meet customer and stakeholder needs in the ecosystem. As organisations continue to invest in their ecosystem, especially in R&D and capability development, they will gradually begin to develop 'home-grown' STIs, which will enable them to build competitive advantage. The build-up of innovative capabilities will enhance the reach and richness of the organisations' portfolio of products, services and business models.

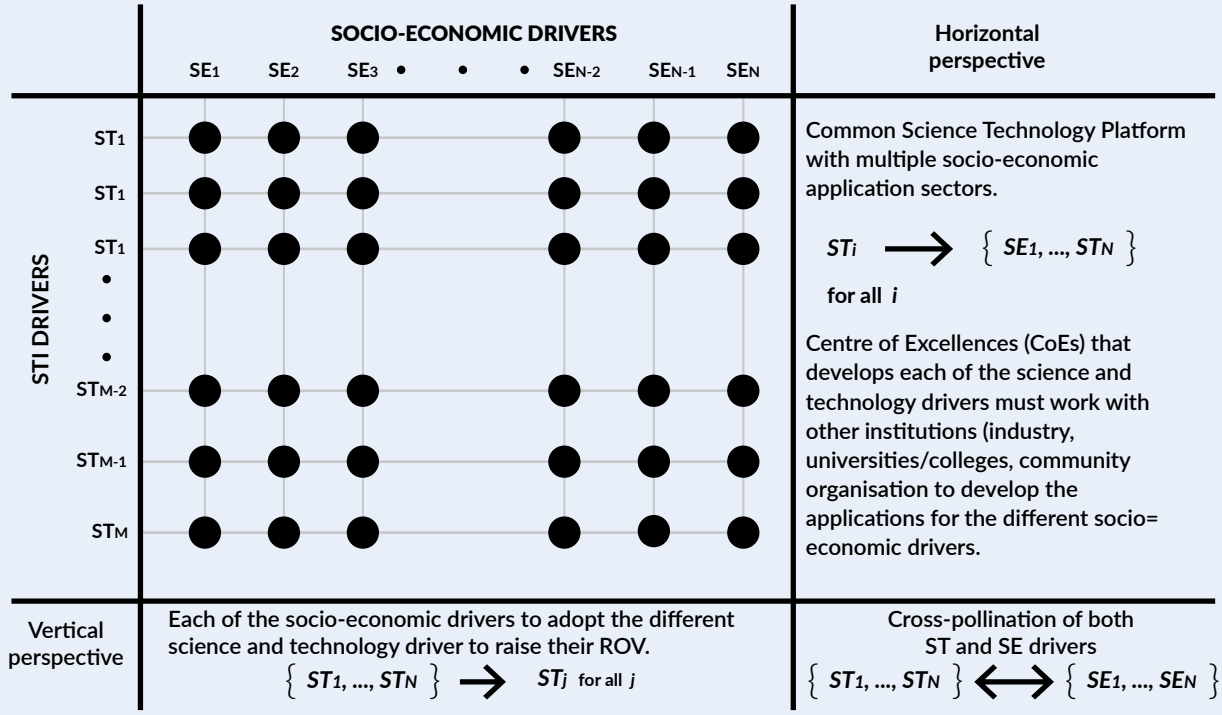
Figure 10: Components and Evolution of Dynamic Capability

2.6 STIE Strategy: Convergence in STI and Socio-Economic Drivers

The global economic architecture is being transformed by rapid development in STIs. While many developed countries have well-integrated STI plans within their economic development agenda. However, this not so prevalent among developing countries. Many of the STIs planned in the developing world are not congruent with the economic needs of their countries, industries and societies. Thus, the STI investments have little or no impact on enhancing economic development and improving the quality of life of citizens. In particular, the impact of STI on vulnerable and marginalised communities is low [10]. STI can also have a significant impact on improving domestic firms' competitiveness. Unfortunately, many industries in developing countries are users of foreign STIs. Very few are creators of home-grown STIs that have strong regional and global footprints [11].

In this section, we highlight that a carefully curated STI strategy with economic development, jointly developed by government, industry, community organisations and institutions of higher education, can play a key role in nurturing the development of local STI sectors. Strengthening local capabilities when developing STI plans will help increase the adoption of locally developed STIs in the domestic economy, as well as increase their ability to penetrate global markets. For this to be realised, curation of a vibrant ecosystem that adopts the 8R Philosophy and 8i Ecosystem is critical in nurturing strong dynamic capabilities. Strong dynamic capabilities within the ecosystem, through the development and adoption of new STIs, will add value to the economy's various sectors. This proposed framework, called the 8R-8i STIE Ecosystem, integrates global STIs with the socioeconomic drivers of a country, as shown in Figure 11. Each of the STI drivers has the potential to increase the ROV of the socioeconomic drivers.

Figure 11: 8R-8i STIE Ecosystem: Convergence of STI and Socio-Economic Drivers



[10] Refer to Academy of Sciences Malaysia, ASM (2015, 2017a, 2021).

[11] Refer to the case of Malaysia, Economic Planning Unit, Prime Minister's Office Malaysia, EPU (2016a), MyKE-III (Phase 1) and EPU (2016b), MyKE-III (Phase 2).

Strong convergence of STI drivers and socioeconomic drivers enabled by a sound STIE ecosystem is envisaged to unlock the following four spill-over impacts on the economy and society:

- **Spill-over Impact 1:** Converging STIs will deepen one another to create new recombinant STIs (as shown in Figure 12).
- **Spill-over Impact 2:** Converging STI platforms will foster stronger convergence between the different socioeconomic sectors (as shown in Figure 12).
- **Spill-over Impact 3:** Strong convergence in both STIs and socioeconomic sectors will reinforce and deepen one another to increase STI and economic spill-over that will raise the ROV, especially pertaining to economic, social and environmental development (as shown in Figure 12).
- **Spill-over Impact 4:** A discovery in any one of the STI and socioeconomic nodes can have a spill-over impact on other STI-socio-economic nodes (as shown in Figure 13).

To capture the multiplier impact, the STIE ecosystem must consider both the 8R Philosophy and 8i Ecosystem model, as shown in Figure 4 and Figure 8, respectively.

Figure 12: Spill-over Impacts that Spawn New STIs and Socio-Economic Drivers

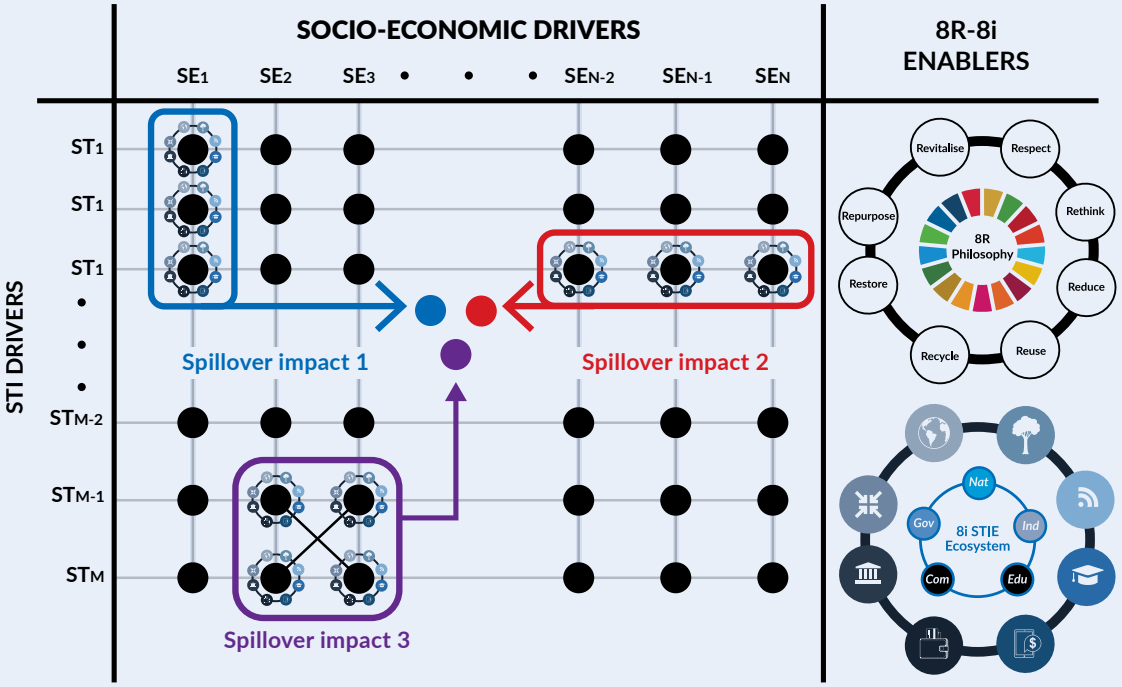
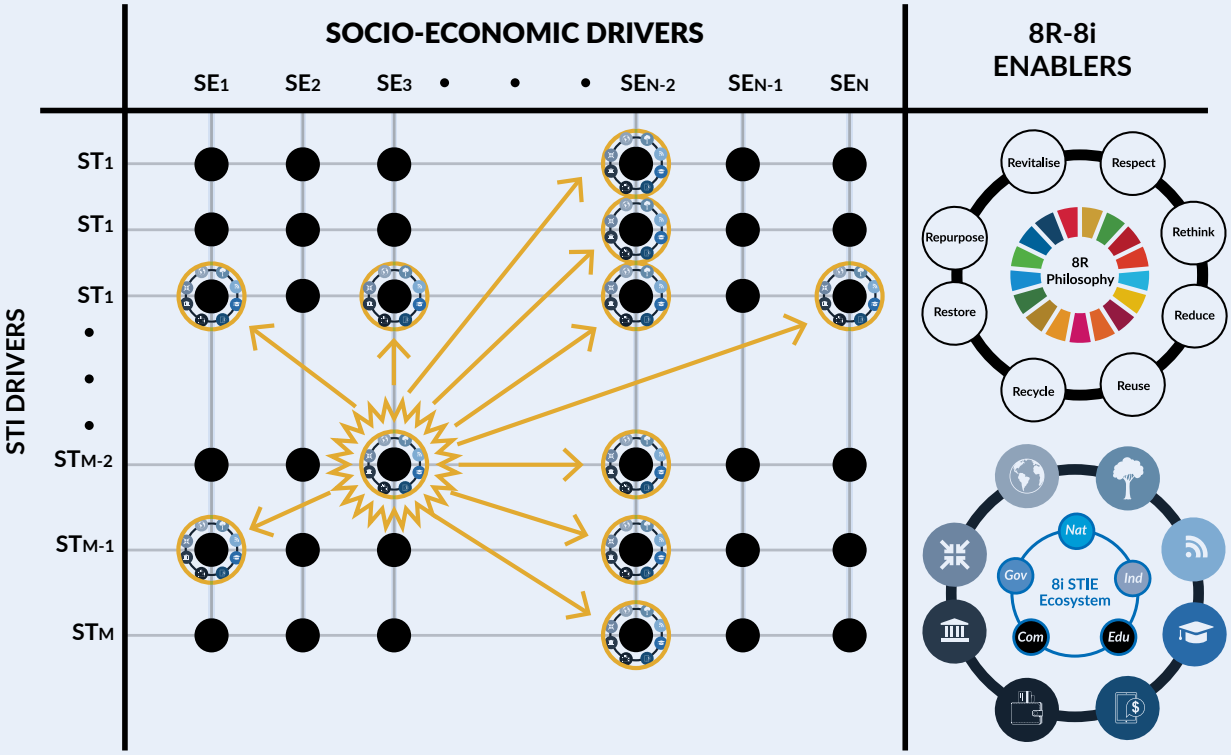
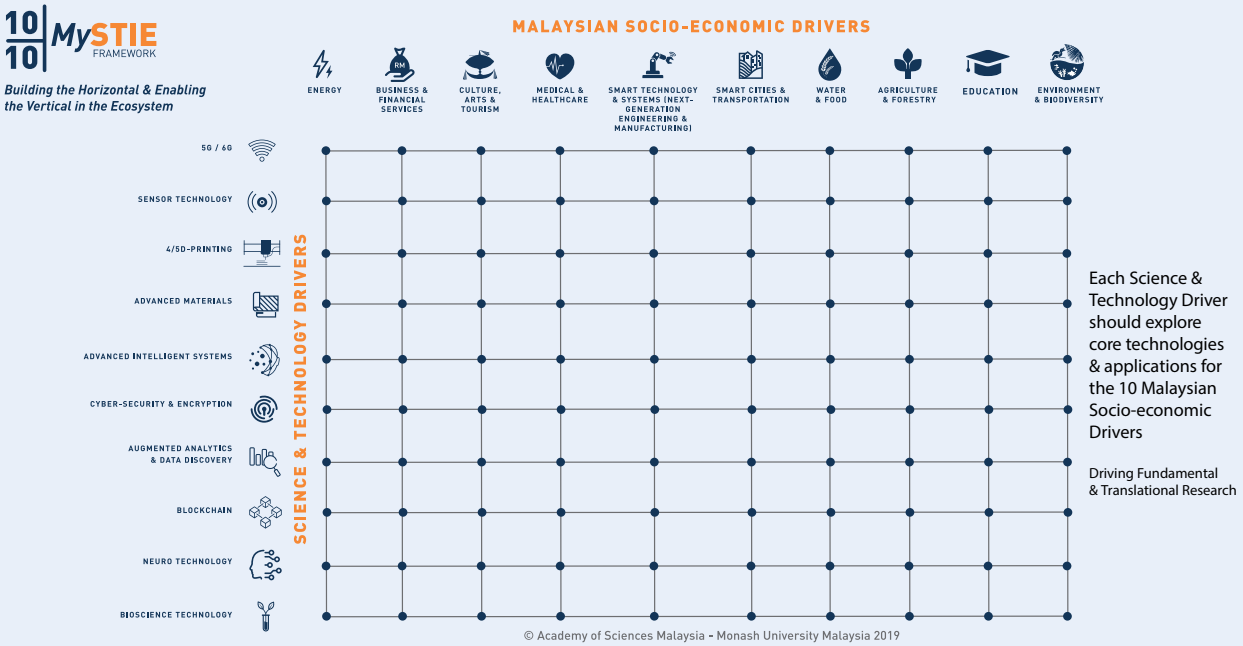


Figure 13: Knowledge Diffusion - a new innovation in one node spills-over to other nodes



An application of the 8R-8i STIE Ecosystem is the 10-10 Malaysian Science Technology Innovation and Economy (10-10MySTIE). The 10-10 MySTIE integrates Malaysia's 10 global science and technology drivers and 10 socioeconomic drivers, as shown in Figure 14. An example of a spill-over impact derived from the 10-10 MySTIE framework for the halal industry is illustrated in Figure 15. A well-curated halal ecosystem using the 10-10 MySTIE framework can initiate new recombinant innovative technologies (both catch-up and leap-frogging technologies). These will have significant socioeconomic spill-over impacts on other sectors of the economy, such as agriculture and forestry, culture, arts and tourism, medical and health care, and business and financial services. Application of the 10-10 MySTIE and the spill-over impact to other socioeconomic sectors can be found in the Academy of Sciences Malaysia (ASM) (2020).

Figure 14: An Application of the 8R-8i STIE Ecosystem Framework (10-10 MySTIE)

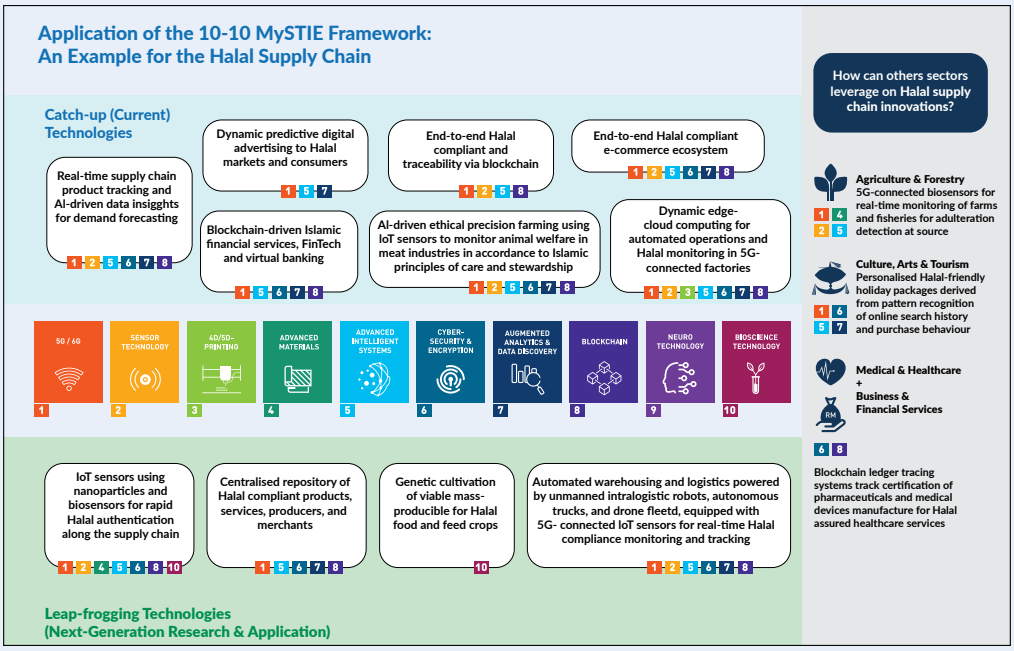


Each Malaysian Socio-economic Driver should explore how the 10 Science & Technology Drivers will value-add and enhance their global competitiveness

Source: Academy of Sciences Malaysia (ASM) (2020).

Note: The S&T drivers were clustered based on the global technology identified from the emerging technologies identified in ASM (2017b), patent analysis and consultation with industry and leading experts in the field. The socioeconomic drivers were identified from: 12 National Key Economic Areas, the Ministry of International Trade and Industry's three catalytic sub-sectors and two high-potential-growth areas, nine National Science Research Council (NSRC) priority areas and seven Ministry of Education research-grant clusters.

Figure 15: Example of STIE Spillover Impact for the Halal Supply Chain

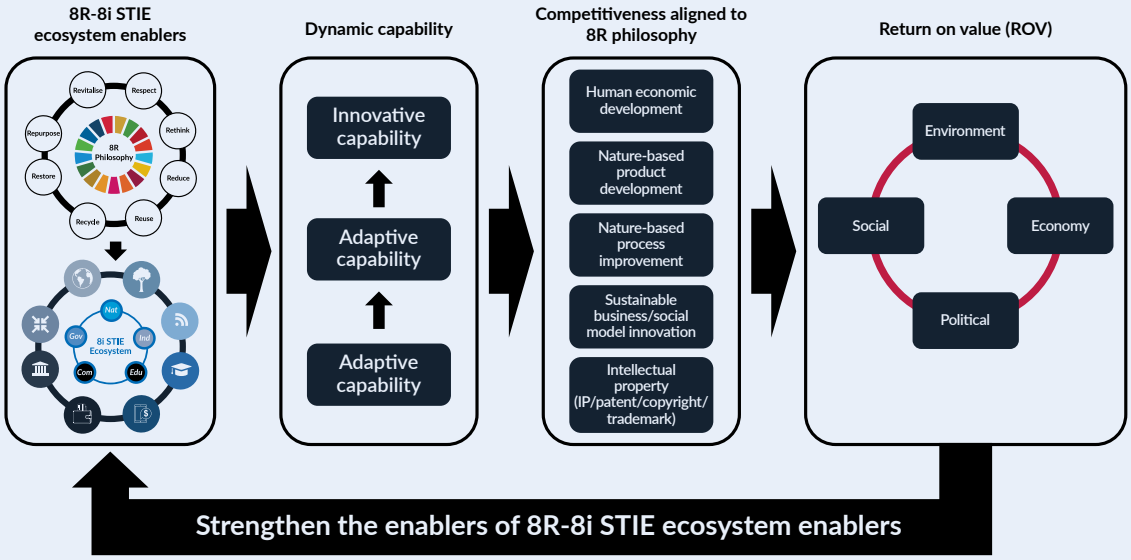


Source: Academy of Sciences Malaysia (ASM) (2020).

03 | THE 8R-8I STIE ECOSYSTEM: SPAWNING MULTIPLE VALUE CHAINS

Transition up the global innovation value chain by firms, communities and countries requires careful development of the STIE ecosystem enablers. A sound STIE ecosystem anchored with a nature-centric philosophy (8R Philosophy) is envisaged to build strong dynamic capabilities. This will lead to an increase in the competitiveness of industries and organisations, and hence will increase the communities and nation's ROV. That is, improving the quality of the environment, empowering the local community to improve their quality of life, intensifying upward social transformation of the local community and enhancing the competitiveness of local industry. All of which will help to increase economic prosperity. Countries, communities that create greater ROV are in a better position to invest additional resources towards continuously strengthening STIE ecosystem enablers, as shown in Figure 16.

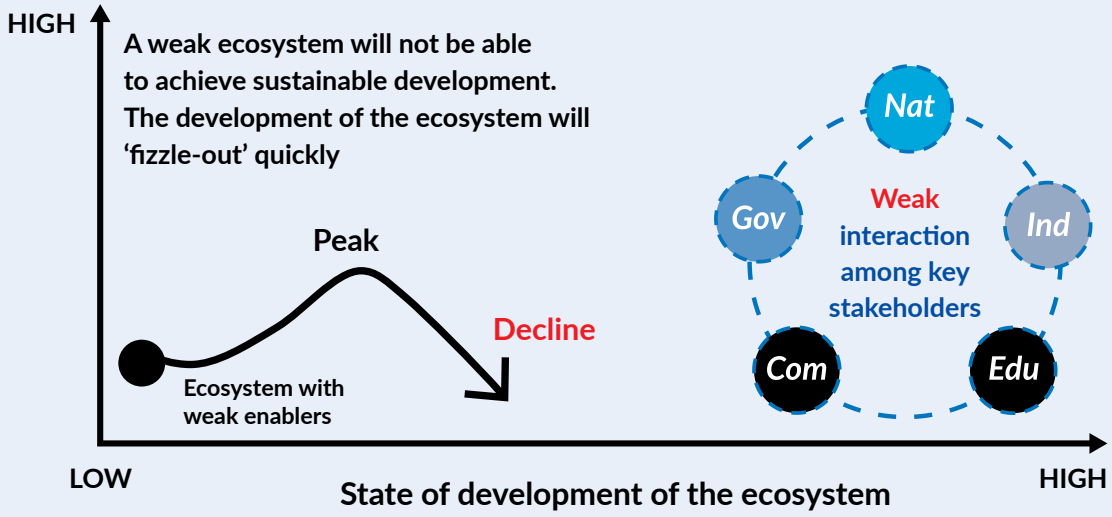
Figure 16: 8R-8i STIE Value Chain



Weakness in any of the enablers will undermine cooperation and co-creation efforts among key stakeholders in the ecosystem. This results in weaker dynamic capabilities and, in turn, weaker ROV growth trajectory of the ecosystem and organisations within it (as shown in Figure 17) [12].

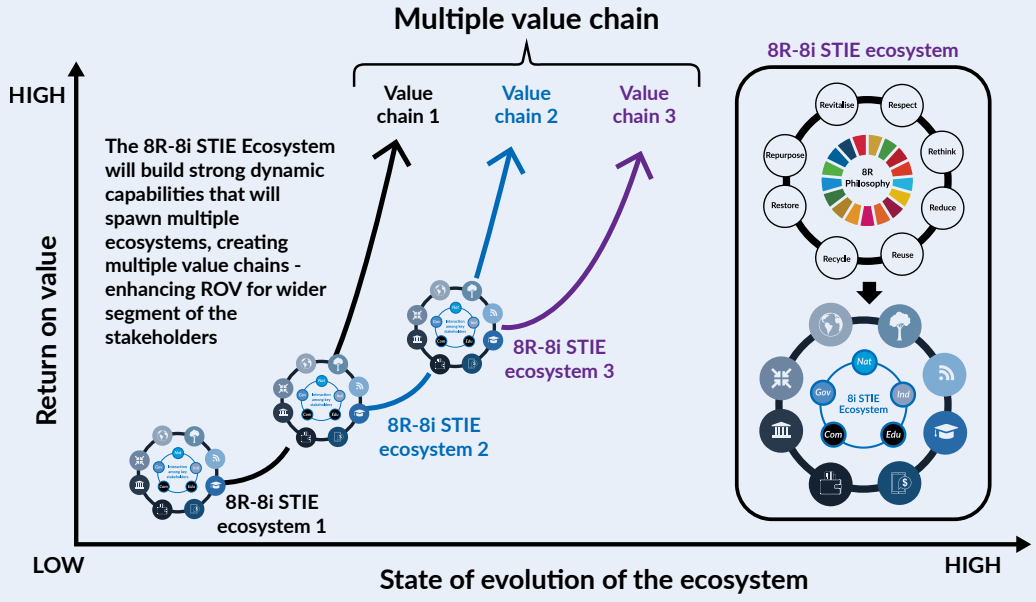
[12] The Economic Planning Unit (EPU) (2016a, 2016b) studies show that for many of the industrial sectors in Malaysia, weaker ecosystems have led to lower knowledge sharing among members. Hence, many of them found it difficult to build strong adaptive and innovative capabilities. These adversely affect the competitiveness of local industries and their contribution to the wealth of the country.

Figure 17: Unsustainable STIE Ecosystem



In contrast, strong enablers of the ecosystem have the potential to strengthen the dynamic capabilities of organisations and industries in the ecosystem, creating four types of STI spill-over impact, as shown in Figures 12 and 13. The ecosystem is able to continuously improve and upgrade itself by scanning the market environment regularly and undertaking fore-sighting exercises to future-proof against market volatilities and other external shocks. Strong market intelligence informs organisational investment strategies and ultimately leads to improved products, services and business models. Revenue streams from these will help create the next-generation sustainable ecosystems, which can then create multiple new income streams, as shown in Figure 18. This helps mitigate risks associated with market uncertainty and volatility.

Figure 18: Spawning of Multiple STIE Ecosystems and Value Chains



04 | THE 8R-8I STIE ECOSYSTEM: MOVING UP THE COMPETITIVENESS VALUE CHAIN

The proposed ecosystem framework for competitiveness postulates that the ROV for firms, countries and communities is dependent on the state of development of the 8R-8i STIE Ecosystem. Here, we categorise the development of the ecosystem into five stages, as shown in Figure 19.

Stage 1: Laggard's Ecosystem—Low Absorptive Capability

At this stage of development, several of the ecosystem building-blocks are not in place and the ecosystem experiences difficulties in building absorptive capability. There is a major capital outflow and brain drain. There is also under-employment of the assets in the ecosystem, a high potential of rent-seeking and moral-hazard behaviour. Additionally, the ecosystem experiences low economic development, high unemployment and social problems. There is a widespread use of unsustainable economic and business practices, including low use of scientific methods, potentially leading to a high risk of environmental degradation and biodiversity loss. Firms operating in this ecosystem also have low awareness and adoption of environmental, social and governance (ESG) standards and best practices.

Stage 2: Imitator's Ecosystem—Building Absorptive Capability

This ecosystem represents the early stages of the development of 8R-8i STIE Ecosystem enablers. Economic agents in this ecosystem are building absorptive capabilities and are highly dependent on external knowledge and STIs for their development. Many of the institutions and economic sectors operate in silos (closed STIE systems are prevalent) and are locked into the lower end of the value chain. Firms' competitive advantage is based on cheaper input factors. Wages remain low and, in many cases, economic development is at the expense of the environment (unsustainable business practices). Rent-seeking and moral-hazard problems continue to be a challenge. The adoption of ESG standards is relatively low among economic agents in this ecosystem.

Stage 3: Adapter Ecosystem—Building Strong Absorptive and Adaptive Capabilities

The 8R-8i STIE Ecosystem enablers are developing at a rapid pace and economic agents are building strong absorptive and adaptive capabilities. Firms and organisations in this ecosystem are utilising external knowledge to develop local solutions. These solutions add value to their operations and those of other external stakeholders in the ecosystem. There is greater sharing of information and knowledge among key stakeholders in the ecosystem (emerging open STIE ecosystem). Collaboration among the players in the ecosystem leads to the emergence of knowledge networks and industrial clusters. These networks and clusters start generating the four types of STI spill-over impact (as mentioned earlier), which help industries to improve their productivity and competitiveness. There is also an increasing understanding and adoption of ESG standards. Improvements are experienced across all four dimensions (social, economic, political and environmental) in this ecosystem.

Stage 4: Mature Ecosystem—Building Strong Absorptive, Adaptive and Innovative Capabilities (Vibrant and Dynamic National Value Chains)

The 8R-8i STIE Ecosystem enablers are in an advanced stage of development, enabling economic agents to build strong absorptive, adaptive and innovative capabilities. Firms and organisations in this ecosystem are seamlessly utilising external knowledge to generate indigenous (local) knowledge and STIs to enhance their competitiveness. There are strong STI developments that are inter-linked with the economic and industrial clusters (national open STIE ecosystems). These STIE developments are aligned to the 8R Philosophy. This ecosystem operates at the higher end of the national value chain. There is also high awareness and adoption of ESG standards and circular economy models. Strong gains are experienced in upward social mobility, economic development, political empowerment and social transformation, and adherence to environment and biodiversity conservation standards.

Stage 5: Pace-Setter Ecosystem—Building Strong International Knowledge Value Chains and Sustainable Supply Chains

This ecosystem is constituted by strong and highly sophisticated enablers of the 8R-8i STIE Ecosystem. The ecosystems in this grouping are linked with other leading STIE ecosystems across the globe. The economic and industrial clusters in this ecosystem adopt an open STIE ecosystem framework, which fosters strong inter- and intra-ecosystem collaborative partnerships. This enables seamless flow of new knowledge across local and global knowledge networks and supply chains. Ecosystems at this stage of development are also at the forefront of adopting and leading innovation, which powers national, regional and global socioeconomic drivers. There is regular fore-sighting of STIE developments by key stakeholders, and this sets the tone for strategic planning onfuture development of global value chains. These ecosystems are also major attractors of foreign direct investment and R&D funds, enabling them to develop frontier technologies and innovations along with the four STIE spill-over impacts. These developments lead to high ROV for all stakeholders, which has a positive 'knock-on' effect on the competitiveness of industries, environmentally friendly socioeconomic development as well as improved quality of life of people in the ecosystem.

In summary, countries and communities that continuously strengthen their STIE ecosystems have a higher probability of moving up the competitive value chain, including the possibility of leap-frogging stages of development, as shown in Figures 19 and 20, respectively.

Figure 19: Moving up the Competitiveness Value Chain

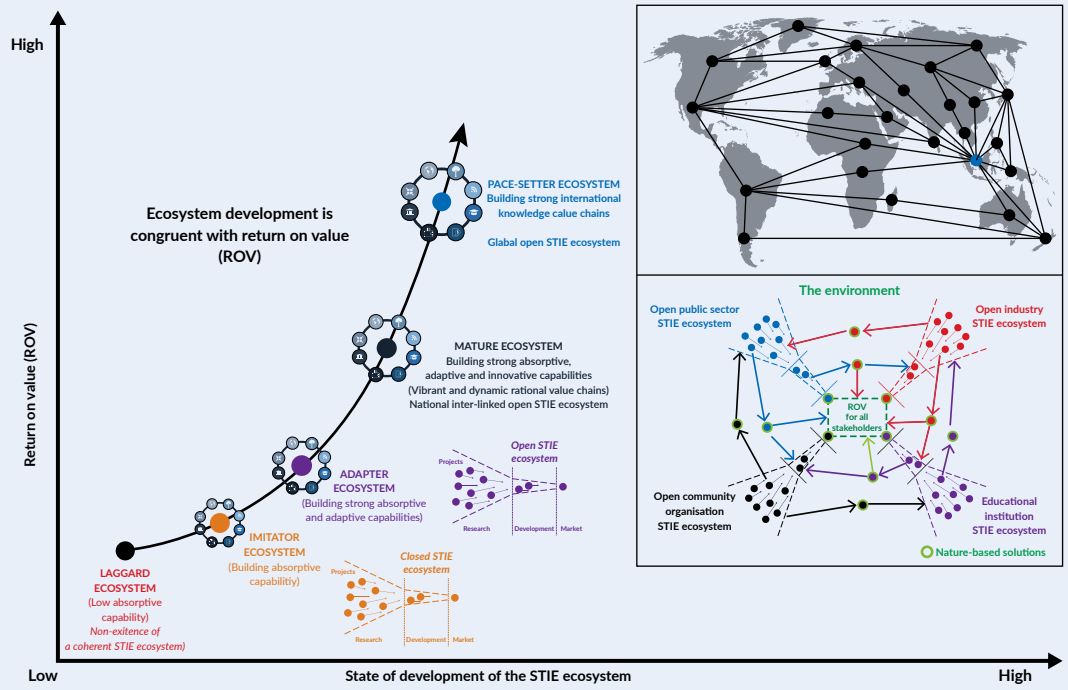
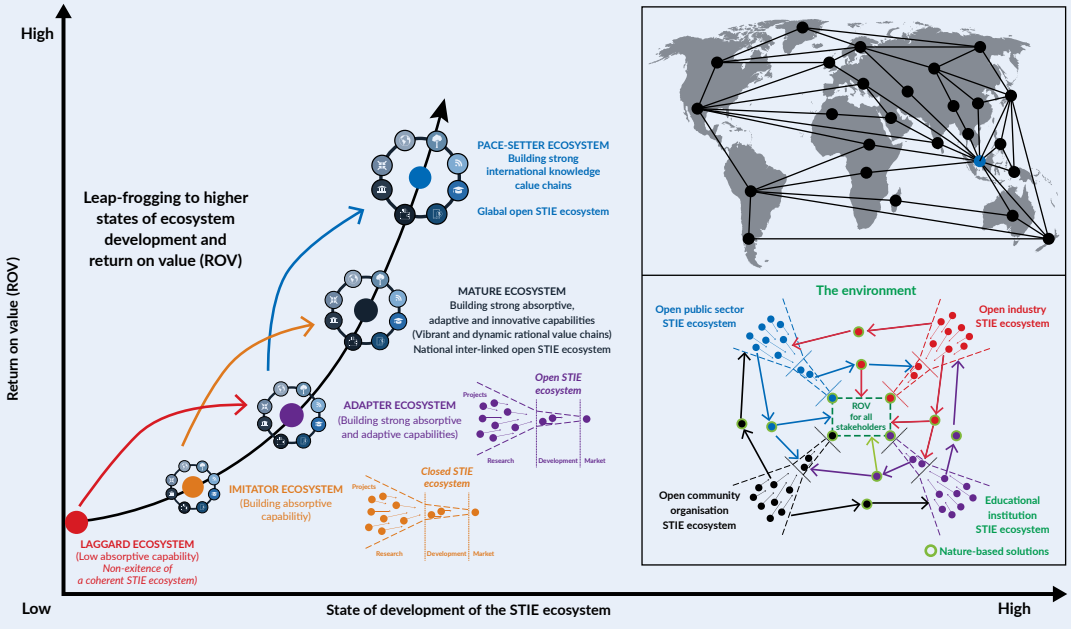


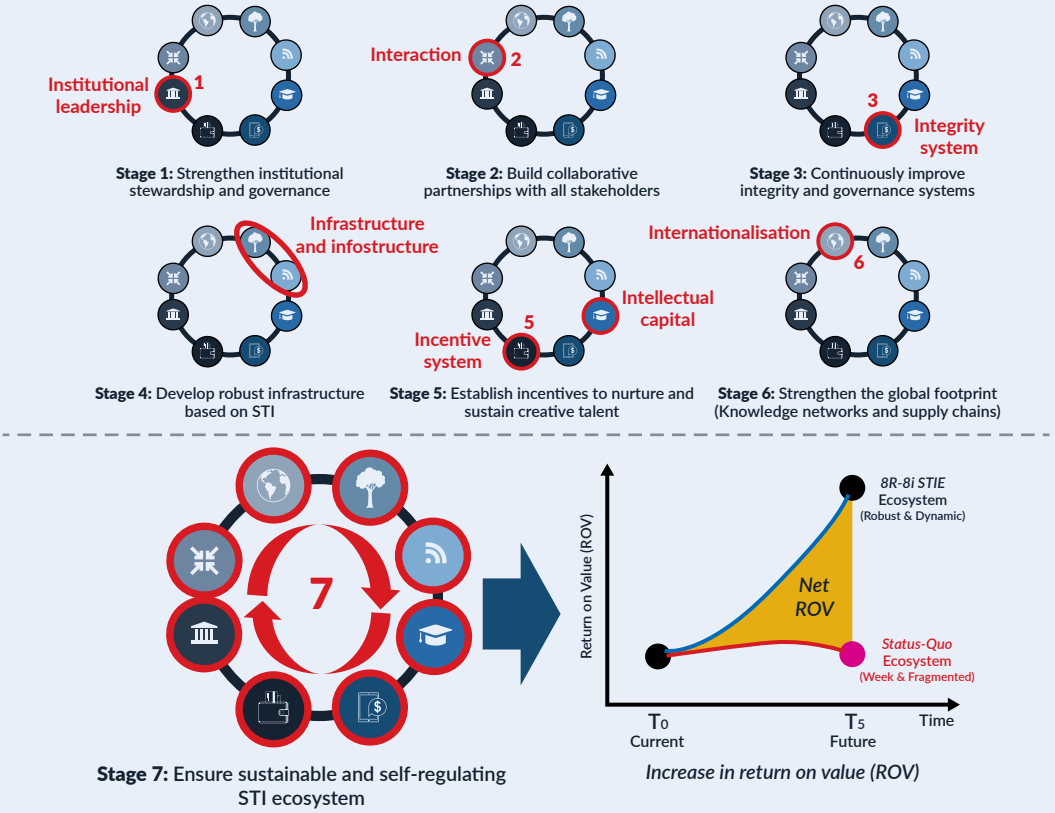
Figure 20: Leap-Frogging Up the Competitiveness Value Chain



05 | KEY LESSONS & CONCLUSIONS

In this paper, we highlight that ecosystems aligned to the 8R-8i STIE Ecosystem framework have the potential to achieve sustained development and transition to a high level of competitiveness. The rapid development of STIE ecosystem enablers provides firms, countries and communities with the opportunity to leap-frog to a higher stage of development. Achieving this requires a systematic and staged development approach to strengthen ecosystem enablers, as outlined below and shown in Figure 21.

Figure 21: Systematic Development of the STIE Ecosystem



Stage 1: Strengthen Institutional Stewardship and Governance

Strengthen the institutional governance of organisations in the ecosystem, by adopting a "Whole-of-Government and Whole-of-Society" approach to enable the development of an agile and robust STIE ecosystem aligned to the 8R Philosophy. This requires building leadership within organisations that is sufficiently diverse and able to access a wide range of perspectives to foresee, predict and navigate highly competitive, uncertain and volatile global landscapes.

Stage 2: Build Collaborative Partnerships with All Stakeholders

Nurture and sustain multi-stakeholder partnerships based on mutual trust. This requires establishing incentives and mechanisms for key players in the ecosystem to work together with a common objective to continuously enhance the ROV for all stakeholders in the ecosystem.

Stage 3: Continuously Improve Integrity and Governance Systems

Strengthen and continuously improve governance and integrity systems to ensure adherence to global best practices, aligned to the 8R Philosophy. This can be done by ensuring a robust regulatory architecture, implementation mechanisms, tracking and monitoring systems, reporting mechanisms and business-friendly policies are in place to nurture a high-performance knowledge-sharing culture. Building a high-performance culture requires the ecosystem to be anchored on a ROV-KPI-driven performance development system at all levels of the organisation.

Stage 4: Develop Robust Infrastructure Based on STI

Incorporate advanced and nature-based technology in all infrastructure development projects. This is to ensure that all development projects balance socioeconomic needs with environmental imperatives, and derive greater ROV from the conservation and sustainable use of natural assets in the ecosystem. Advanced use of technology can be deployed to enable the integration of the different knowledge systems. These technology and systems are critical for providing seamless access to information for strategic decision-making that is aligned to the 8R philosophy.

Stage 5: Establish Incentives to Nurture and Sustain Creative Talent

Increase the quality and quantum of industry-ready talent aligned to national development priorities. These include ensuring appropriate incentive systems are in place to attract creative talent and reduce brain drain. This also involves access to the right level of R&D funding, capability development programmes and other support systems to enhance innovation and creative endeavours among the local workforce and industries.

Stage 6: Strengthen the Global Footprint (Knowledge Networks and Supply Chains)

Implementation of Steps 1 to 5 leads to a sound and dynamic STIE ecosystem, which can be further enhanced through international collaboration and partnerships. This will facilitate knowledge and technology transfer, enabling the ecosystem to move up regional and global STIE value chains.

Stage 7: Ensure Sustainable and Self-Regulating STIE Ecosystem

Continuous development of the enablers of the STIE leads to a sustainable and dynamic STIE ecosystem aligned to the 8R Philosophy. This, in turn, contributes to the following: sustained and environmentally friendly socioeconomic development; increases the competitiveness of local industries; and improves the quality of life of people.

A sound STIE ecosystem, as outlined in the seven steps above, is envisaged to increase the ROV for communities and industries in the ecosystem. Weakness in STIE ecosystem enablers hinders the development of robust dynamic capabilities (absorptive, adaptive and innovative) in key stakeholders in the ecosystem, reducing the competitiveness and ROV of the ecosystem and its contribution to the nation.

The global economic landscape is undergoing rapid transformation powered by STIs. Countries, organisations and communities that invest in developing robust, dynamic and agile STIE ecosystems will be in a better position to navigate the waves of transformation, They will also benefit from better ROV outcomes, higher local industry competitiveness, environmentally friendly socioeconomic development and improved quality of life for their citizens. Future research should contextualise the above theoretical underpinnings to different economic sectors and social systems; and empirically validate them.

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