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**The Triple Helix As A Model for Economic
Development
A Background Paper**

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The Triple Helix As A Model for Economic Development

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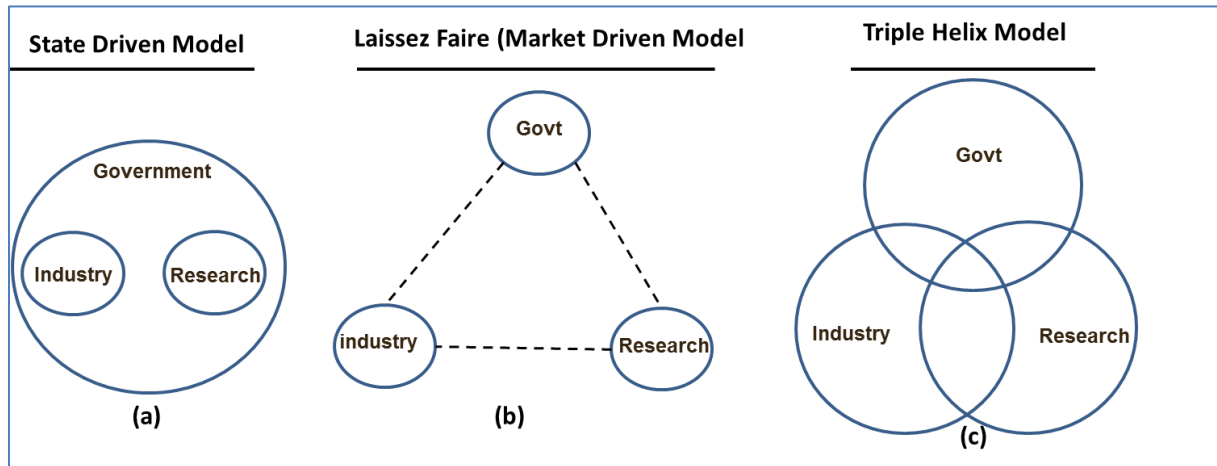
I. Introduction and Rationale

Economic development is the process of increasing supply of goods and services and consumption of these resulting in improved livelihoods. By nature goods and services are scarce and thus increasing supply requires innovations in technologies to convert natural and knowledge capital to goods and also innovations in business models to make this conversion economical i.e. make goods and services affordable. The university is crucial in generating knowledge and knowhow that underpins innovations while the industry is key in commercializing knowledge and innovations. Both these efforts require considerable mobilization of resources. There is also need for markets to allow for exchange of goods and services and also coordinate production activities through price signals. Government play a crucial role setting the rules of the game, facilitate the functioning of markets and also incentivizing actors to participate in otherwise risky economic activities. More crucially government provides public goods. Public goods are especially critical in ensuring that basic knowledge continues to be created and putting critical pieces of the infrastructures needed to facilitate production and distribution of goods and services. Therefore public investment is a significant enabler and indeed a catalyst for private investment.

Economic development is thus at the heart driven by innovations and their commercialization into goods and services. Thus a knowledge creation and innovation eco-systems, a vibrant industry and a well-functioning government are the key ingredients of sustainable development. How these core enablers of innovation work together is crucial in determining the dynamism of any economy and its resilience. This is key as developments especially in technologies and business models are not linear. Development trajectories are occasionally punctuated by disruption as innovations (new technologies and also new business models) emerge and change the way goods and services are created and consumed. Therefore one's comparative advantage can be wiped out. This has been described as creative destruction process by Schumpeter (1945).

Traditionally industry and government have been the prime movers of this processes. However, as society has shifted from an industrial society to a knowledge society the role of knowledge and thus the university has become more crucial. yes The mission of the university has been expanded from teaching and research to encompass a more direct role in socio-economic development. The university, the industry and the government are now the core drivers of development in a knowledge economy. For a country the key to being competitive depends on how the three key drivers are organized. Fig 1 shows various arrangements. But do we really capture then also for example infrastructure?

Figure 1: Configurations of University-Industry-Government collaboration



Source: Etzkowitz and Leydesdorff (2000)

The Figure 1(a) shows the arrangement where government sets the agenda and the industry and university follows suit. This model has the least dynamism and largely explains the failure of central planning as an economic organizing paradigm. Fig 1(b) shows the more common arrangement in a laissez-faire model. Here each does their task independently with some weak communication and coordination. Each guided by its mission. While this market driven economic model is now widely accepted as sensible economic model, it has some weaknesses as lack of coordination means market failure do occasionally occur. Also innovations are seen as the domain of the industry with University mainly acting as a producer of research and a provider of human capital and government as regulator. Under this arrangement however, research can happens but it is not commercialized, skills are developed but not relevant to industry, public investment occur but not coordinated with private investments thus opportunity for unlocking synergies lost. Thus the arrangement is least prepared for turbulence that comes with creative destruction especially in increasingly competitive and dynamic knowledge driven economies.

The best environment for innovations are created at the intersection of the three spheres. The formal recognition of the need for the three actors and potential synergies that can be derived through deliberate and purposeful bringing the three spheres together so that they can act in concert is known as the Triple Helix (TH) approach. Central to the TH approach is the blurring of boundaries between government-industry-research/knowledge institutions with institutions assuming some roles of “the other” In this way the relationships among the institutional spheres of the university, industry and

government are continuously reshaped in an endless transition bringing forth new technologies, new firms and new types of relationships in a sustained and systemic effort (Etzkowitz, 2003). The close collaboration between government, research and the industry/private sector, has veritable heritage with powerful examples of the ability of this model when well executed can drive economic development¹. The realization of role of innovation systems has seen government play more pro-active role in driving innovation seen in entrenched in law. Brazil's 2004 Innovation Law incentivizes the interaction between firms, public universities and research centres, allows grants to innovative firms, the set-up of private firms' incubation facilities in public universities and shared use of university infrastructures (Ranga and Etzkowitz 2013).

II. The Triple Helix System

The Triple Helix system is a set of; (i) Components (the institutional sphere of university, Industry and Government with a wide array of actors); (ii) the relationships between the components (include technology transfer, collaboration, conflict moderation, substitution and networking) and (iii) function/ processes taking place (the key function of triple helix systems is to generate, diffuse and utilize knowledge and innovation).

Ranga and Ektowitz (2013) point that the Triple Helix is essentially a combination of several spaces;

- a) The knowledge space (with a critical mass of knowledge resources),
- b) An innovation space characterized by hybrid organizations and entrepreneurial individuals and institutions
- c) A consensus space where triple helix actors brainstorm, discuss and evaluate proposals. The consensus space is crucial in catalyzing the interaction between the knowledge and the innovation spaces This regular interaction is key in generating trust and shared vision and developing rules of the game. The consensus space is also key in creating interdependence as people start seeing themselves as part of a larger entity. Business and professional networks can play a key role in establishing the consensus space. The hugely successful Oxford University cluster

¹ The US is perhaps the most powerful example of application of the Triple Helix Mode though this is not obvious. Much of the innovations we see today including internet were incubated by the government in Universities and commercialized by private sector though government funding mainly channeled through the military. The land grant university systems can also be loosely categorized as triple helix model with the land grant university being the lead

has over 60 professional and business networks that coordinate and encourage interaction of entrepreneurs and ideas (Smith and Bagchi-Sen 2010).

Some key points to note about the TH model include:

- Triple helix systems focus on boundary permeability among the institutional spheres as an important source of organizational creativity, encouraging individuals to move within and between the spheres and engage in recombination of elements to create new types of organizations.
- As pointed out key to success of the triple helix systems is the overlapping of boundaries. Thus the quality and quantity of the relationships created across the spheres is key. The quality of the network is key. Networking for purposes of enhancing cohesion, breaking down boundaries maybe as important as R&D outcomes (Ektowitz nd)
- R&D is not the only driver of innovation. Other activities like technology adoption, incremental changes, imitation, and combining existing knowledge in new ways can also increase organizational innovative capacity especially for emerging countries.
- Bringing the three spheres together means needs to resolve tensions and also conflicts of interest. In addition there is also need for convergence and confluence of interest. Priorities have to be set no longer solely on intellectual goals but also with an eye to the resource available, research agendas and an ex-ante assessment of likelihood of success (Leydesdorff, 2000).
- The key is to clearly understand how the element in the triple helix link formally and informally to support the innovation system and then seek to design policies that will strengthen the links that are valuable to the relationship (Smith and Bagchi-Sen 2010).
- The University-Industry-Government relationship require new learning (should we explain this?), communication and service routines that produce, diffuse, capitalize and regulate processes of generation and application of useful knowledge. The new pragmatic relationship is interactive concerted effort embedded in projects, communication and new kinds of shared values.

III. The Case for Local Economic Development

Though the Triple Helix (TH) model can be applied at the national level perhaps where this model is most apt is at local development level. Innovation occurs in an institutional, political and social context. In this view, innovation is seen as a geographical process and innovation capabilities should be sustained through knowledge sharing regional

communities. Innovation occurs more easily when geographical concentration and proximity are present, and therefore a regional cluster takes a crucial dimension in such processes².

For regional driven innovation system to be effective the region needs not only scientific and technological institutions they also need to have innovation supportive instruments such as investment mechanisms and institutions to promote concerted action. It is also particularly important to have structures that link regional to national level. The bringing between regional and national is key to tapping national resources that can be substantial and many times funding mechanisms tend to be highly centralized at national level. In designing consensus spaces this is crucial consideration (Rodrigues and Melo 2012).

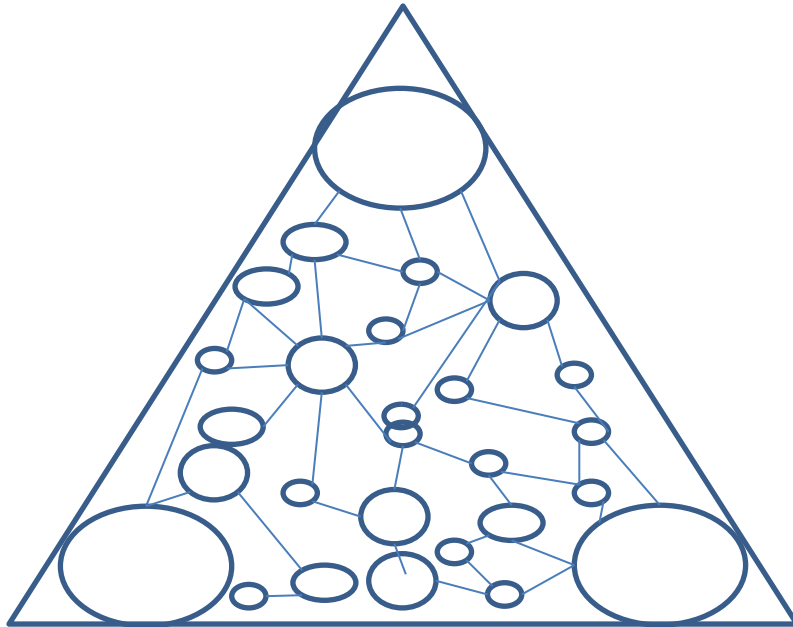
Note that the ultimate objective of a regional economic development policy is really to create a “Commons”. The “Commons” include the shared resources that companies and communities rely on in order to be productive. Every successful company and every region begins with certain foundations – an educated populace, pools of skilled labor, vibrant networks of suppliers, strong infrastructure, basic research that can be commercialized (Fulkner et. al. 2017). The “Commons” is crucial for shared prosperity that is at the heart of a successful economic development strategy. The commons forms the basis for emergence of clusters, the engines of local economic development

Clusters

As pointed the local or regional level is the appropriate place to locate triple helix model as it affords the potential for tighter collaboration that is key to regular and sustained problem solving needed to build competitive clusters. This can over time create very strong innovative clusters that can drive the development of the region through upskilling and creation of industries. The industries can eventually spawn world class firms over time and become prime movers of national development. Clusters enhance firms’ competitiveness through agglomeration economies. This is due to presence of high skills, specialized suppliers and service provides, improved market access and circulation of information.

² A regional cluster is defined as a ‘group of firms in the same industry, or in closely related industries that are in close geographical proximity to each other is meant to include geographically concentrated industries included so-called ‘industrial districts’ (Marshall, 1922).

Figure 2: Triple helix driven cluster



Clusters provide a framework for organizing the implementation of many public policies and public investments. (Porter 2014). They are powerful tools for driving economic development as they:

- Leverage the power of **spillovers** and **linkages** to drive rapid economic development;
- Are a vehicle for policies and investments that strengthen **multiple related firms/institutions** simultaneously;
- Enhances the efficiency and effectiveness of **traditional economic policy** areas, such as training, R&D, export promotion, FDI attraction, etc.;
- Are forum for **collaboration** between the private sector, trade associations, government, educational, and research institutions –A **mechanism** for **constructive** business-government dialog;
- Brings together **firms of all sizes**, including SME's;
- Are a powerful private/public vehicle to identify and get alignment on **problems** and **action recommendations**;
- Fosters **greater** and **more sophisticated** competition rather than distorting the market;

The emergence of a vibrant cluster is dependent on developing strong economic foundations. These are policy, finance, research, skills development and infrastructure (USAID 2003 cited in De Boer and Langat, 2014). Each sphere of the triple helix has a role to play though intensity may vary as hypothesized in table 1. Yes

Table 1: Triple Helix role in cluster development

Economic Foundation	Government	Industry	University
Policy	High	Moderate	High to moderate
Financing	Moderate	High	Low
Research	Moderate	Moderate	High
Skills Development	High	High	High
Infrastructure	High	Moderate	Low

Source: Adapted from De Boer and Langat (2014)

IV. Building: The Triple Helix - Approaches

The key to a powerful triple helix system is the breaking of boundaries and each sphere interfering in the other. For example, University can incubate firms and thus move into the industry space, Industry can create company universities, the government can become a venture capitalist through funding of small business development funds (Etzkowitz nd). The key prerequisite however is the existence of agglomeration of knowledge resources or concentration of R&D activities.

Triple Helix also requires a prime mover. Note that the driver of the triple helix can be any of the three nodes. When government leads the process then this is a top down model. Policy drives the process. When industry or academia drives then a bottom up process happens. But the two processes are not distinct as government can initiative the process say through encouraging industry and then industry leaders can takeover. This dual track process is more productive than any single path (Ektowitz nd). For example young entrepreneurs can initiate new activities and government entrepreneurial programs can take over.

Some examples of a triple helix driven regional development initiative under the leadership of the different nodes are described below to underscore that success using TH model can be achieved through various pathways:

a) Private Sector Driven Triple Helix

The Eindhoven region of the Netherlands is a great example of Triple Helix cooperation. With Phillips as the lead firm working closely with the University and the local government to drive innovation and develop a strong cluster of knowledge industries. Phillips has clearly been the leader of the triple helix. Philips plays a crucial role

particularly for its strong R&D and its role as incubator for start-ups. Phillips also pays researchers at the Technical University of Eindhoven (TU/e). The TU/e in turn provides the region with high-skilled people and enhances its economic spin-off. The municipalities try to retain an attractive living climate and location factors. To ensure the smooth functioning of the model, the region has set up an institute for Triple Helix cooperation, Brainport. Brainport supports and coordinates cooperation between government, university and industry. Industry leaders, the board of the university and representatives local government form the board of Brainport (Van der Meer et al., 2008). The result is that Eindhoven is now one of the most vibrant and resilient regions in the Netherlands. trucks.

b) University Driven

The university driven triple helix model is best epitomized by highly successful high technology clusters around Stanford University and MIT in the US and Cambridge and Oxford Universities in the UK. Universities are now at the center of regenerating regions as they can bring new knowledge to local areas. Universities can form cornerstones of regional clusters by attracting knowledge intensive business around their strong research base and ready supply of skilled people (Rodrigues and Melo 2013).

The Oxfordshire county expertise in biomedical research lies in a combination of university, charitable trust and government funding. However, the primary centre of research is the Oxford University³. The city of Oxford has nine hospitals which host the research laboratories of Oxford University. The county of Oxfordshire also has several secondary centers of research including Oxford Brookes University, which specializes in Life Sciences. Being close to Oxford University was found to be the key decision of many companies that had located themselves in Oxfordshire (62%).⁴ Also over half of the companies in the biomedical sectors were spin-outs of the University of Oxford underscoring the central role of the University driving the cluster (Smith and Bagci-Sen 2010).

c) Government Driven

³ The university is ranked as the third best biomedical university behind Harvard and Cambridge

⁴ This was the second most important reason for location decision after quality of life (note that in earlier survey done in 2002, being close to University was the most important reason for locating in Oxfordshire (72% of the respondents)

Thailand has used the triple helix model to develop a competitive poultry industry. Through its Industrial Technology Assistance Program (ITAP) of National Science Technology and Development Agency (NSTDA) it sought to be a bridge between basic R&D and Development R&D⁵. It has effectively linked university and industry. ITAP supports ranges from identification of problems, guiding firms to solutions, getting suitable solutions and also funding through matching funds. Where R&D is needed, ITAP will coordinate with researchers in the university and provide funds for R&D to be undertaken. ITAP is thus the key intermediary in driving the flow of knowledge. ITA has Industrial technology advisors that help mediate between industry and research. ITA has also developed regional networks that work with a University in a particular region. For example King Mongkut's University of Technology Thonburi (KMUTT) is the key in the KMUTT-ITA network for Western Region. Through this network KMUTT-ITA has managed to support the development of 8 products for the poultry industry that were previously imported. This saw incomes of the product manufacturers increase by 20% and product sales by 10% (see Klomklieng *et. al.* 2012 for further details).

V. Enabling Triple Helix

The fact that the key elements of an innovation system are in place does not necessarily mean that the dynamism of a TH system will be unleashed. Studies on failure of innovation systems identify a number of challenges that could inhibit the development of an innovation system. Woolthius *et. al.* (2005) provides a framework for understanding innovation failure that has two key dimensions; (i) Missing actors and (ii) Systems Failures. The missing actors include demand (consumers), Firms, Knowledge institutions (universities, technology institutes) and third parties (banks/VCs, intermediaries/consultants etc). Systems failures include Infrastructure failures (ICT, roads etc.) and Institutional failures (hard laws, norms, values etc.). The two dimensions then form a matrix that can be used to analyze gaps in innovations. However Cai *et. al.* (2018) argue that this framework is too complicated and the reason it has not been used much.

Ranga and Etzkowitz (2013) identify the key enabling conditions for triple helix as:

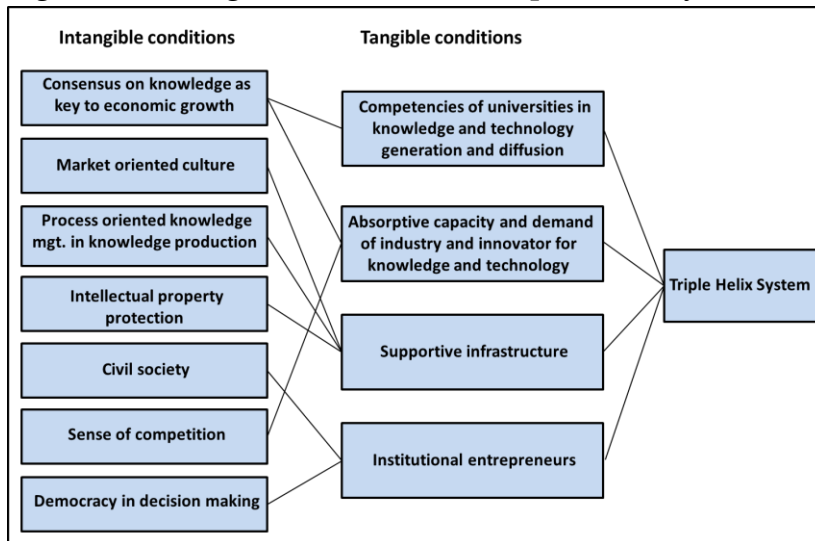
1. Competencies of universities in knowledge and technology generation and diffusion;
2. Absorptive capacity and demand of industry as? innovator for knowledge and technology;

⁵ This is the so called valley of death, moving from patent or a research product to a commercial product

3. Supportive infrastructures, including policy and fiscal measures for formation and development of high tech start-ups, university spin-offs, and other kinds of organization for university technology transfer;
4. Institutional entrepreneurs who enunciate a vision for knowledge-based development and bring leadership of the three phases together. Key here are innovation champions across the three spheres who have sufficient respect and authority to exercise convening power.

Cai et. al. (2018) argues that the Ranga and Etzkowitz (2013) framework is too generic and does not adequately address political and social context might affect the Triple helix. Drawing from institutional theory, they treats the triple helix development as process of institutionalization involving four stages: (i) realization of needs; (ii) intra-organizational transformation; (iii) inter-organizational interactions and (iv) institutionalization. Using this institutional logic they develop seven enabling intangible conditions that focus on the more general contextual factors and four tangible conditions elaborated by Ranga and Etzkowitz (2013) that focus on specific performance (see fig 1.2). They argue that the role of innovation policy in a regional innovation systems is through its influence in the enabling conditions.

Fig 1.2: Enabling Conditions for a Triple Helix System



Source: Cai et. al. 2018

Smith and Bagchi-Sen (2012) argue that many researchers fail to properly recognize some key features that make triple helix work. They make the following points:

- While the existence of a research university is key, other types of universities and education institutions may also play a key role especially in building capacity.

- The danger of overemphasis of scientific excellence at the expense of other equally important social and economic processes operating within global knowledge frontiers. Also key is the capacity to attract talent from around the world
- The presence of a university per se is the key attraction for the private sector but the high quality talent and availability of technical resources are also crucial. Other important factors include: Quality of life; proximity to likeminded companies; availability of funding; access to specialist services; access to networks; access to mentors; proximity to partner organizations; proximity to markets; proximity to a big city.
- Indirect science and technology policy that develops favorable economic ecology like facilitating incubators, provision of vendor funding and professional business advice
- Geography factors matter a lot, so what works in one location may not work in another. The characteristic of the region, stage of development, degree of specialization and the innovation support are key.

VI. Approaches To Partnerships

The key success of the Triple helix is building effective partnerships. Two approaches to building partnerships are Public Private Partnerships (PPPs) and Inclusive Business models.

a) Public-Private Partnerships (PPPs)

Public Private Partnerships (PPPs) are generically defined as ‘a form of cooperation between government and business agents – sometimes also involving voluntary organizations (NGOs, trade unions) or knowledge institutes – that agree to work together to reach a common goal or carry out a specific task, while jointly assuming the risks and responsibilities and sharing resources and competences’. (Bouman, S., et al. 2013),

PPPs covers a wide range of transactions where the private sector is assigned some responsibility, including investment. It ranges from management contracts with no investment obligations to concessions contracts with significant investment obligations in addition to operational and management obligations” (Marin, 2009)

The World Bank argues that PPPs can bring greater efficiency and sustainability to the provision of public services such as water, sanitation, energy, transport, telecommunications, healthcare, and education. PPPs can also allow for better allocation of risk between public and private entities.

In theory, PPPs can be considered a preferred option when market and/or institutional failures exist that prevent the delivery of goods and services with a net development impact. In practice, however, most PPPs are motivated for financial reasons in order to mobilize additional resources that enable the execution of large public programs.

PPPs are increasingly seen as vehicles for national development and many countries are establishing PPPs units within governments to oversee these collaboration. They tend to focus mainly on large infrastructure projects. There are few PPPs that have a research or knowledge institutions as an integral part of the arrangement. All the same this model can be applied to formalize the Triple helix approach especially where the three parties can formalize the cooperation through forming a joint venture corporation to run the collaboration initiative. This can inoculate the operation from day to day politics and operational issues of the collaborating organization and thus creating a focus on developing the triple helix model.

Fulkner et al (2017) argue that PPPs provides a model for economic development that is suited for the polarized politics that democracies sometimes spawns where consensus is hard to reach. They argue that the benefits of these kinds of actions is that they are “win-win-win”: they benefit citizens, communities, and businesses. They tend to rely more on pragmatic leadership than ideology, so membership in these efforts can be inclusive.

b) Inclusive Business (IB) Models

Another common approach that has gained considerable interest is incorporating the poor in business value chains. This means that the poor are either part of supply chains or the distribution chains. Inclusive Business models are really extensions of Corporate Social Responsibility. So rather than providing charity companies finding innovative ways to help local communities be part of their value chains so then they earn income while also providing valuable service. For instance brewing companies in a number of African countries including Sierra Leone, Ghana, Nigeria, and Kenya and have developed smallholder farmers as supplier of sorghum feedstock and thus substitute imported barley. This has involved working closely with governments ministries⁶, local government and NGOs to develop the supply chains.

This model are a win-win and they can be considered at Strategic CSRs. Indeed they have become a very popular United Nations in 2008, launched Business Call to Action (BCtA) aims to accelerate progress towards the Sustainable Development Goals (SDGs) by challenging companies to develop inclusive business models that engage people at the base of the economic pyramid (BoP) – people with less than US\$10 per day in purchasing

⁶ The government have also given incentives to breweries to shift from barley to sorghum

power in 2015 US dollars – as consumers, producers, suppliers, distributors of goods and services and employees.⁷.

Inclusive business provides a platform for business, NGOs and local governments to work together each leveraging the unique capability. IB is also an unique platform for collaboration with business schools to develop new knowledge in supply chains and doing business at the bottom of the pyramid. Indeed a study by GIZ (Rosler et al ?nd.) points that while IB has good potential to promote development, there is need for further research. They point that little data is yet available regarding the development impacts of inclusive business, and it is not clear yet whether inclusive business faces regulatory hurdles that will require specific action to be taken at policy level. The report also argues that there is need for further research regarding the barriers (both external and internal) to achieving scale, which companies applying IB models face – and how to overcome those barriers.

VII. Understanding The Challenge of Building Triple Helix

The previous sections have highlighted the potential impact of a triple helix and what need it would take to put one in place. The reality is that putting a TH system in place can be a major challenge. To get insights on what it takes to develop , execute and building a triple helix based regional development strategy, we use two in-depth case studies.

a) The Case of Brightlands Chemelot Campus⁸

⁷BCTA is a unique multilateral alliance among donor governments – including the Dutch Ministry of Foreign Affairs, the Swedish International Development Cooperation Agency (SIDA), the Swiss Agency for Development and Cooperation, the UK Department for International Development (DFID), the US Agency for International Development (USAID), and the United Nations Development Programme, which hosts the secretariat. Over 200 companies, ranging from multinationals to social enterprises, and working in 67 countries, have responded to the BCtA
<https://www.businesscalltoaction.org/business-call-action>

⁸ Brightlands consists of four campuses embracing the following areas of expertise: Smart materials and sustainable manufacturing (Brightlands Chemelot Campus, location Sittard-Geleen); Regenerative medicine, precision medicine & innovative diagnostics (Brightlands Maastricht Health Campus, location Maastricht); Data science and smart services (Brightlands Smart Services Campus, location Heerlen); Food and nutrition (Brightlands Campus Greenport Venlo, location Venlo).For details see <https://www.brightlands.com/about-brightlands>

The Brightlands initiative of the Limburg province of the Netherlands is a very ambitious triple helix local economic development strategy. The Initiative was triggered by forces of change that threatened Limburg province economic prospects. The traditional economic base of petrochemical industry was being threatened as competence in knowledge economy became the key competitive advantage. The key private sector player in the region, DSM, had already seen that and had embarked on a transformation strategy. This had seen DSM sell of its petrochemical division and was making a shift towards knowledge industry. It was also not clear whether DSM was going to stay in the region as it made the transition. This development had raised serious concerns for the province as it sought to protect employment and also transition to the region to knowledge based economy. The province leadership saw the answer as adoption of a triple helix model to drive the region to a new development trajectory. It sought to tie DSM to the region and also bring on the University of Maastricht (UM) under a new strategy called *Versnellings* agenda ('Acceleration agenda'). The agenda identified three cluster for development; health, chemical and agro-food.

Though the *Vernellings* agenda was launched in 2005 nothing much happened afterwards. The period 2010-2012 saw the first concrete measures when a number of projects were designed and executed. These were

- The real estate of Chemelot campus, an open innovation campus
- Establishment of a venture fund to fund entrepreneurs
- The development of a science program
- The establishment of advanced shared services (Enabling technologies)
- Establishment of Chemelot Innovation and Learning Labs (CHLL). CHLL connects business and students. Business that have a research question can hire students to answer questions.
- Institute for Science and Technology (InSciTe). An institute of biobased and biomedical materials. The key investment was three pilot plants that business in the Chemelot campus can use as bridge between Research labs and full scale plant facilities.

The key turning point for the *Vernellings* agenda was the establishment of the Chemelot B.V., a joint venture between the government of Limburg, UM and DSM, each with a 33.3% share, in 2012. The company became the vehicle for driving development agenda. The vehicle was also a way for the three parties to make long term commitment. The formation of Chemelo B. V. meant also meant that development could progres faster as decisions were not tied to bureaucratic process of the mother institutions.

(see Joosten 2014 for the detailed case study)

The Brightlands has since grown to a vibrant innovation ecosystem. The Brightland Chemelot campus has grown to 77 companies, 1,900 employees and 660 students (). Collaborations are the hallmark of Brightlands with more than 300 companies showing serious interest. Some notable collaborations include;

- Aachen Maastricht Institute for Biobased Materials (AMIBM): This is a collaboration between Maastricht University, RWTH Aachen and the Fraunhofer institute. AIBM addresses the question of how plant materials can be used directly from nature as the basis of chemical and applied materials
- Chemelot InSciTe: This is a collaboration between Brightlands, Maastricht University and University of Eindhoven. The focus is slowly dissolving materials and implants in the body. Breaking down biowaste into building blocks.
- TNO: This is led by Brightlands in collaboration industrial and academic partners. The focus is on application of advanced polymer materials in the field of Lightweight Automotive materials, 3D printing and Optoelectronic materials.

(See <https://www.brightlands.com/>)

Brightlands Chemelot Campus has the ambitious target of having 2,900 knowledge workers, 1,000 students and more than 100 participating companies by 2023 (Brightlands 2016).

Lessons

The government of Limburg province was thus the prime mover of the THM centered around campus development that brought the three key actors co-investors in a campus designed to catalyze the emergence of the knowledge economy. The process of forming the triple helix was by no means easy. The government of Limburg had to deal with many issues. These include

- Persistence of old mindsets: Key to a successful THM is the blurring of traditional boundaries of the key actors. However this was a challenge. UM was reluctant to invest in real estate as it saw itself as an educator and researcher.
- Mistrust: DSM corporate strategy in the near future was unknown to the province and DSM was not communicative. Further its desire to get rid of its real estate signaled potential of retreat from the region.
- Power Asymmetry: DSM kept the door of leaving/divesting from the region open thus used this a leverage to get resources. Indeed both DSM and UM continued to

take advantage of political pressure that the regional government felt to create jobs and cajole the government to make investment it may not have wanted especially providing subsidies. The result is that province had to invest 100% for facilities for Institute for Science and Technology (InSciTe) as opposed to having all parties invest.

- Governance: Management of TH system was a challenge as province did not have expertise to run the Triple helix organization created. An outside expert had to be hired.
- Leadership: Progress was slowed significantly when leadership at provincial level changed and new leader who was not sold on the agenda and was also suspicious of DSM. UM leadership was slow embracing the idea of blurred boundaries and continued to hold on to the traditional role of university. It was reluctant to invest in real estate (the campus).
- Political challenges: Key to getting funding especially from national and European government depended on getting national politicians on board. However national politician want credit and have short time horizons. Therefore national politician gave half-hearted support for the initiative.

(see also Joosten 2014)

b) The Columbus Partnership: A Case study of a PPP Driven Local Economic Development

The region of Columbus in Mid-Western United States is a good example of a true PPP effort to drive local economic development. Public and private leaders in Columbus region had seen that the region was not keeping pace with the nation in income and employment growth the way it had in the 1980s and 1990s. Columbus was struggling in the 2000's and had only created 10,000 jobs. This was despite the fact that the region was home to several fortune 1000 companies and also had the second highest concentration of college students (second only to Boston Area).

The economic recession of 2008–2009 generated a sense of urgency for a regional growth strategy. In the face of high unemployment rates and depressed investment, the business leaders felt the need to act. Led by two private sector CEOs⁹ who mobilized CEOs of private companies, not-for-profit organizations, presidents of local universities to form

⁹ Key drivers were, L. H. Wexner the CEO of L Brands,, a fortune 1000 company headquartered in the region and Jhn F. Wolfe, the publisher of the Columbus Dispatch

the Columbus Partnership¹⁰. The Columbus Partnership worked closely with the 11 local governments in the Columbus region and the local communities to co-create a regeneration strategy – The Columbus 2020.

The Columbus 2020 Strategy

The Columbus 2020 strategy development, engaged more than 500 community leaders from across the 11 Columbus Region counties. The task force assembled crystallized the issues afflicting the region as:

- Sub-Optimal efforts: Lack of a common aspiration and shared vision. The collaborations were too limited and resources utilization fragmented. Our resources. The result is simple, yet daunting: sub-optimized efforts. The result was anemic growth.
- Image: The region was associated with terms that have negative connotations, e.g., a “rust belt” location with “high union concentration.” The
- Inability to translate innovation to commercial applications: Education and research efforts did not pay off – too many college students had to move to other regions as the region lagged behind other regions in translating innovation into commercial applications.
- Fiscal constraints: Government and nonprofit faced budget constraints in the tough economic climate endangering many of the elements that make up the quality of life.

A Strengths, Weaknesses and Opportunities and Threat (SWOT) Analysis found that the strengths of the region outweigh challenges. The key strengths include: home to strong corporate leadership; a growing and nourishing entrepreneurial environment; top-tier universities; globally connected distribution infrastructure; and rising foreign investment and trade. The region was also one day drive to half of the population of USA and Canada.

The study found that opportunities abound throughout the Region, particularly through greater collaboration to foster innovation, coordinate education and training, and increase logistical connectivity and exports. Capturing these formed the core of the Columbus 2020 strategy. In 2010, the Columbus 2020 Regional Growth Strategy was launched. Columbus 2020’s mission is to generate opportunity and build capacity for economic growth for the region. This was a decade-long plan to achieve four bold, long-term economic goals by the year 2020:

- Add 150,000 net new jobs

¹⁰ The Columbus Partnership is a non-profit, membership-based CEO organization of more than 65 CEOs from Columbus’ leading businesses and institutions. The Columbus Partnership’s primary goal is to

- Attract \$8 billion of capital investment
- Increase per capita income by 30 percent
- Be recognized as a national leader in economic development

To drive the vision, Columbus 2020 Foundation, a nonprofit organization was established. Funding for the organization is received from private companies and public entities that are member of the Columbus partnership. Working as part of a network of state and local partner, Columbus 2020 key activities are:

- Retain and expand the economic base through outreach to existing businesses in the 11-county Columbus Region. This includes helping existing businesses expand and become more competitive
- Conduct outreach to market-leading and growing companies around the world in order to attract investment to the Region that will diversify the economic base
- Create the environment required for high-growth companies, entrepreneurs and technology commercialization to thrive.
- Improve the civic infrastructure required for economic base growth by providing a platform for the open exchange of ideas, aggregating information for policy makers, and working to enhance the human and physical infrastructure necessary for economic growth
- Develop a distinct identity and brand that raises awareness of the Columbus Region as a business location
- Accelerate startups and high-growth businesses by connecting them with local resources, venture networks and consumers
- Identify economic development challenges and opportunities through customized, objective research

(see also <https://columbusregion.com/columbus-2020/strategy/>)

Impact

The strategy has largely achieved the 2020 goals even before the target date. By 2018 the region had created over 160,000 jobs, attracted more than \$8 billion in investments (Wartenberg 2018) and on the way to meet all the targets by 2020¹¹. From 2011 to 2013, the Region had an annual average of 22 FDI project announcements, double the 11

¹¹ <http://www.columbuspartnership.com/community-impact/economic-development/>

announcements per year from 2000 to 2010. The Region's exports of \$11.3 billion in 2013 were up 61 percent from \$7 billion in 2003 (Brookings and JPMorgan , 2018).

The success of the partnership has been a model for many cities and regions in America and worldwide. Harvard Business School has even created a case study on the Partnership for use in the Young American Leaders Program at the School (see Rivkin, 2015).

Collaboration

Much of the success of the Columbus can be attributed to collaborations that have included all configurations of collaboration from industry-industry to industry-university, industry-government and government-university. Some notable ones include:

- Ohio Export Internship Program. This program matches companies looking to export for the first time or to improve their current export initiatives with students who have taken export-focused coursework, while providing a 50 percent reimbursement for intern wages (Brookings and JPMorgan 2018).
- The Columbus State Community College has partnered with Honda of America to develop a talent pipeline of electro-mechanical engineering graduates to address an urgent need. This co-op program enables students to start while still in high school, work at Honda as students, and transition to full-time employees upon completion of their associate degree. Students pursuing further career development, earn their bachelor's degree in engineering through the Preferred Pathway 2+2 partnership with Miami University, with their tuition paid by Honda (CSCC, 2017).
- Colleges and universities in Ohio, we have partnered with the Insurance Industry Resource Council which includes 13 leading Ohio-based insurance companies to prepare the industry for the 26,000 jobs that will be open over the next five years. This partnership has resulted in an educational pathway that mirrors the professional career path in the industry, ranging from a claims certificate to a graduate program in insurance. The program has been designed to attract mature workers in transition, including military veterans. Nationwide Insurance has had a specific focus on bringing veterans into their organization, hiring more than 1,000 into entry-level and professional track occupations CSCC 2017).
- The City of Columbus partnered with Columbus State Community College to establish a program called FastPath designed to quickly get un- and under-employed adults into the workforce. Programs in construction, healthcare, culinary arts, and early childhood education are helping adults in transition enter

or re-enter the workforce. FastPath is part of a “two-generation strategy” as the partners provide assistance to parents re-entering the workforce while providing enrichment programs for their children (CSCC 2017)

- The Albany international Business park which has 5 clusters. The clusters allow close collaboration between business. For example the international Beauty and Personal care campus has 14 companies within a 1.9 mile radius that are part of a vertically integrated supply chains that includes bottle makers, cap makers, labelling and packaging. This enables a company to take idea to a product on the shelf in 7 days where it used to be 3 months before (Wartenberg 2018).

Lessons

The success of the Columbus partnership can be attributed to the following:

- No Silver Bullets: Economic development is not a single project or activity, but rather a host of initiatives that create a culture of sustainable development over the long-term. We must be deliberate and accountable and think long-term
- Inclusiveness: The Columbus partnership includes a diverse spectrum of members – from the largest corporations to the smallest owner-operator business, from The Ohio State University to community colleges, from state government to small community townships and from the city of Columbus to regional communities
- Deliberate and Purposive: As a truly community-developed initiative, Columbus2020! takes a collaborative, deliberate and purposeful approach to every step of the process All stakeholder whether big or small matter and each stakeholder must understand what is at stake, the path forward and the role that he/she plays.
- Leadership needs to be earned: Being a good leader requires that you have followers because people trust you. You have to earn that, you can't command it.
- Humility: The Partnership is very sensitive to the fact that it's a powerful group, so if it gets misdirected, it could do terrible mischief, unintendedly, Its founder Wexner cautions
- Curiosity: Being curious is an ongoing exercise and a fundamental activity that the partnership members practice with vigor. Curiosity expands perspective and ensuring the mission stays relevant as the future unfolds
- Focus: Work hard to insure issues are being identified; seek best practices globally; identify partnerships and experts to bring to the table, and tackle the work

- Collaboration Culture: This group has cultivated a culture of collaboration between the various constituencies-both public and private-that did not exist in the community.”

(See Yost, 2016)

VIII. From Triple helix to Quadruple Helix to N-Helix

The triple helix model has been criticized for putting much emphasis on the three players while leaving an equally important actor namely the civil society and NGOs, the so-called third sector. This sector is key particularly in the developing countries where NGOs provided significant capacity building and also funds for development. Even fairly successful clusters like Oxford University Biotech owes much of its success to charities that have funded research and also played a key role in setting up networks (consensus spaces) that were key to the success of the cluster (Smith and Bagci-Sen 2010).

Carayannis and Campbell (2009) proposes a Quadruple helix. The ‘fourth helix’ of a Quadruple Helix is what they call “media-based and culture-based public”. They argue that knowledge and innovation policies and strategies must acknowledge the important role of the ‘public’ for a successful achieving of goals and objectives. On the one hand, public reality is being constructed and communicated by the media and media system and on the other hand, the public is also influenced by culture and values.

Another potential dimension of the triple helix is internationalization. More and more researchers are seeking collaboration with other researcher to share experiences. Indeed with globalization, one can expect the international-national dimension to be increasingly relevant. The collaboration between Dutch and Taiwan design sector is an example of ways in which the triple helix model is being internationalized. The Dutch Design Post (DPP) is an organization that has been established as bridge between a design triple helix that involves the government, leading designers and SMEs manufacturers and leading technical universities in both countries. Using this model, Dutch SMEs have been able to internationalize, Taiwan students have gained new insights through internship with Dutch designers, Taiwan manufacturers have also been able to upgrade their production capacity through closer interaction with Dutch designers (van Beuren and Goh 2016).

<p>The Dutch Diamond Approach (DDA) to International Development</p> <p>Recognizing the important role that public and private sector can play in driving development, the Netherlands government has officially adopted a public-prate partnership as a key part of its development support deliverly. The approach seeks to bring government (local and Dutch government), the private sector (local and Dutch</p>

private sectors), CSOs and knowledge institutions. This four way partnership has been referred to the Dutch Diamond Approach (DDA).

The approach recognises the value addition of government, the private sector, civil society and knowledge institutions working in partnership to realise development results. Within the Dutch Diamond Approach, the competences of partners are combined and the various goals, funds, risks and responsibilities are pooled together. The corporate efficiency and market-oriented methods of the private sector are linked with the local knowledge of civil society organisations (CSOs). Knowledge institutions contribute their expertise, while governments act as brokers and co-financers

The DDA is premised in the fact that though each party has different goals, tasks and responsibilities each can benefit from working together.:

- Private sector: The private sector gain access to knowledge, expertise, networks and funding. Working with different partners than usual enables them to enter new markets and start up sustainable activities.
- CSO: PPPs enable civil society organisations to extend their influence by linking to new partners. Civil society organisations also gain access to new resources including funding, expertise and marketing approach(es). Cooperation with new partners also leads to new ideas and solutions.
- Research: PPPs enable research institutions to develop and, in particular, to apply knowledge. At the same time, they learn from both the process and the results achieved. Theory and practice are thus brought closer together. This promotes research, innovation and technology both among partners and within projects.
- Government: The government needs other parties to make development possible. It can ensure local participation and provide good enabling conditions. The government can also help to upscale successful partnerships. With its global network, the government can connect partners and leveraging their funds can stimulate development-relevant partnerships. Where necessary, they can also share the risks.

However, NIV(2016) point that the Dutch Diamond Approach is still a work in progress. They point that while there is widespread agreement within the government that solving sustainability issues demands close cooperation with partners and good internal cooperation. In practice, however, working methods sometimes vary considerably. While the Ministry of Foreign Affairs talks about a 'Dutch Diamond approach' and focuses its efforts on wide-ranging cooperation between government, companies, CSOs and knowledge institutions, the Ministry of Economic Affairs and its policy on the top economic sectors refer not to a

diamond but to a 'golden triangle', an alliance between knowledge institutions, public authorities and the private sector. Civil society organisations are not automatically part of this triangle and have to fight for recognition of their role, especially in discussions at national level.

The need to go beyond the four partners approach of the Dutch Development approach has been raised. AIV (2016) argues that given the complex nature of sustainability issues and the great variety of circumstances in which sustainability initiatives are deployed internationally, the AIV recommends the participation of the broadest possible range of stakeholders. Not in a triangle – in an alliance between the government, businesses and knowledge institutions – nor in a rectangle – comprising CSOs and representatives of employers, employees, and trade and industry – but in a true five-point diamond formation, with financial institutions also included in the consultations. They argue that financial institutions like the government, are to a large extent accountable for the conditions in which the activities of companies, citizens and knowledge institutions take place.

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Public-Private Partnerships

<https://www.government.nl/topics/development-cooperation/development-cooperation-partners-and-partnerships/public-private-partnerships>

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Leydesdorff, (2012) cautions that though one may wish to move beyond three dimensions, a fourth or fifth dimension would require substantive specification, operationalization in terms of potentially relevant data, and sometimes the further development of relevant indicators. Without such a perspective, parsimony itself may be a methodologically well-advised strategy. Thus he argues that so long as one is not able to operationalize and show development in the relatively simple case of three

dimensions, one should be cautious in generalizing beyond the TH model to an N-tuple of helices.

For simplicity Triple helix can be construed to automatically include civil society which primarily brings local context and thus acts as knowledge institutions, delivers development and also at times investments in projects.

IX. The Sustainable Development Goals and The Triple Helix

The question of sustainable development has risen to the global agenda. This has been driven by traditional concerns of eradicating poverty in the developing world and renewed concern about the impact of economic policies on the future capacity of the world to sustain the currently trajectories. The sustainability¹² has become an agenda for both poor and rich countries. This is best captured by global concern for the impact of climate change.

In September 2015, the 193 member states of the United Nations adopted, by consensus, a new 2030 Agenda for Sustainable Development.¹³ The Agenda features 17 Sustainable Development Goals (SDGs) and 169 Targets, which UN Member States have committed to implement by 2030.. They stridently recognize that social and economic development depends on sustainable management of the natural environment and its resources – including both abiotic resources such as minerals, in addition to ecosystems and biodiversity. These Goals and Targets are universal (applying to all countries) and interconnected. This is a significant departure from the Millenium Development Goals (MDGs) that were targeted at developing countries.

The scope of SDGs is wide and meeting them will require significant collaboration across countries, public and private sector, government development partners and civil societies. No one single entity can deliver the SDGs. Each actor will need to do something and this something will need collaboration with one or more partners. Some sector are rising to the challenge. For example the mining sector has articulated how it can contribute to the implementation of all 17 Sustainable Development Goals (SDGs) as

¹² Meeting humanity's present needs, without compromising the ability of future generations to achieve their own needs This overarching definition of sustainable development was first proposed by the 1987 Report of the World Commission on Environment and Development, entitled *Our Common Future*. Text available at: <http://www.un-documents.net/wced-ocf.htm>.

¹³ See Transforming our world: the 2030 Agenda for Sustainable Development, UN General Assembly (UNGA) Resolution A/RES/70/1, 25 September 2015. Text available at <https://sustainabledevelopment.un.org/post2015/transformingourworld>.

articulated in the mining atlas (produced by UNDP, WEF and Columbia University Earth Institute)¹⁴ which maps the linkages between mining and the SDGs. The aim of this Atlas is to encourage mining companies of all sizes to incorporate relevant SDGs into their business and operations, validate their current efforts and spark new ideas. The atlas makes the point that success will require substantial partnership between governments, the private sector, communities and civil society. The role of governments, civil society and knowledge institution are envisaged in the following ways: where is here the private sector?

- Governments - as a catalyst to further align mining policies with national development plans and to engage more systematically with industry and local governments to leverage investment for sustainable development
- Communities, development agencies and civil society organizations - to support programmes and efforts to help unlock the mining sector's potential to contribute to a sustainable future and as a stimulus for increased inclusive dialogue and cooperation - Existing and future multistakeholder dialogue forums at the mine site level and the country level as a foundation to integrate the role of mining into the broader discussion of sustainable development and national plans to achieve the SDGs. -
- Universities and learning institutions - as a - Source of ideas and opportunities to convene and coordinate education, research and professional development that address mining and the SDGs.

The Triple Helix model will thus become more and more important in enabling the achievement of SDGs. This underscores the need to better understand how it can be made to work better. This can be achieved through (i) studying the current arrangements of partnerships to identify opportunities strengthening existing arrangements and (ii) study successful case studies so that lessons learned can be transferred to construct triple helix arrangements.

X. Conclusion and Policy Implications

Innovation is increasingly becoming central to any development strategy. Success will come as building on a knowledge based economy that is characterized by highly entrepreneurial firms. The supply of knowledge to drive innovations and providing the environment that is supportive to development of a knowledge economy key. Thus, the close collaboration between university industry and government will become

¹⁴ UNSDSN, CCSI, UNDP and WEF (2015). *Mapping Mining to the Sustainable Development Goals: A Preliminary Atlas*.

increasingly crucial. The triple helix model can be a leverage for regional development through promoting both endogenous and exogenous processes of innovation. However, this is not easy. Key is overcoming mistrust, managing power asymmetry among partners and having the right leadership that can develop a shared vision that is key to developing a strong partnership.

Thus having the key elements together does not mean that a triple helix is in operation. Even collaboration does not constitute a true triple helix if the collaboration is based on one-off engagements with no shared long term strategy. Key is a deliberate effort to create dynamic and long-lived linkages. It not only requires overcoming trust issues but also developed a shared vision and also selling this vision to attract other players and thus develop a vibrant cluster that can then drive the vision. NICE

It is important to note that though university, industry and government are at the core of this model other equally important players need to be included and catered for. The civil society and development partners (including NGO's) are particularly important. Indeed they can be key in developing that consensus space that is key to making the model work. They also play a key role in financing initiatives and also shaping the development policy. Indeed in the developing countries Quadruple Helix is the more appropriate operating mode. However given the short term nature of interventions from NGOs and CSOs (which typically last about 3 years) and also the very specific agenda compared to much longer horizons of the other players, the Triple helix model is still a relevant term but with understanding and incorporation of other partners as need be.

Making the triple helix work will involve action by all parties, however policy will be key in driving the process. Policy should thus seek to:

- I. Understand linkages in the triple helix and strengthen them. Policies could include research funds that can be tapped to solve solutions and to facilitate exchange programs to allow staff to move across
- II. Attract new entrants to the triple helix to develop a critical mass of player R&D and non- R&D actors. Policies here can include improving labour market conditions especially for researchers.
- III. Develop infrastructure and funding options to attract investors and entrepreneurs. This includes development of incubation facilities, science parks etc, creating seed funds and other venture funds.
- IV. Develop new institutional structure to coordinate the development of the triple helix that is free from bureaucratic process and conflicts in interest in parent organization when making decisions.

- V. Develop spaces and platforms to encourage both formal and informal networking and also increased public participation in decision making. This could include funds to support innovation fairs, networks, conferences etc.

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