

Management of Diversification in T&T Innovation in the fourth industrial revolution

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DAVOS 2016 Conference

- ▶ ***“The recent DAVOS 2016 Conference of the World Economic Forum highlighted the fact that we are entering the fourth industrial revolution. Some think that in scale and complexity the transformation will be unlike anything we have witnessed before; but one thing is clear the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society”*** (Kluas Schab, Founder and Executive Chairman of the WEF).
- ▶ **Entrepreneurs/Engineers who are charged with the production of things and novel ideas are both the initiators of the revolution and those whose responses must be to the benefit of all.**

Economic Development

- ▶ **Innovation is about building new products and services that are globally competitive**
- ▶ **In our case it is about exports that also provide jobs and in country wealth**

Industrial Revolutions

- ▶ The industrial revolutions the world has already witnessed, focussed on improvements/innovations in automation and connectivity.
- ▶ The first used water and steam power to mechanise production and via early automation via machinery and improved national connectivity via the construction of bridges, roads, railways.
- ▶ The second revolution, wherein automation allowed mass production and fostered efficient, productive connectivity via the division of labour, used electric power.
- ▶ The third was driven by electronics and the digital technologies and introduced more sophisticated automation and increasing connectivity between humanity and the natural world.

Fourth Industrial Revolution

- ▶ **The Fourth Industrial Revolution is building on the third and had been occurring since the middle of the last century.**
- ▶ **This revolution is being driven by extreme automation and connectivity especially through wider implementation of intelligent systems- artificial intelligence.**

Immense Control, Automation and Communications

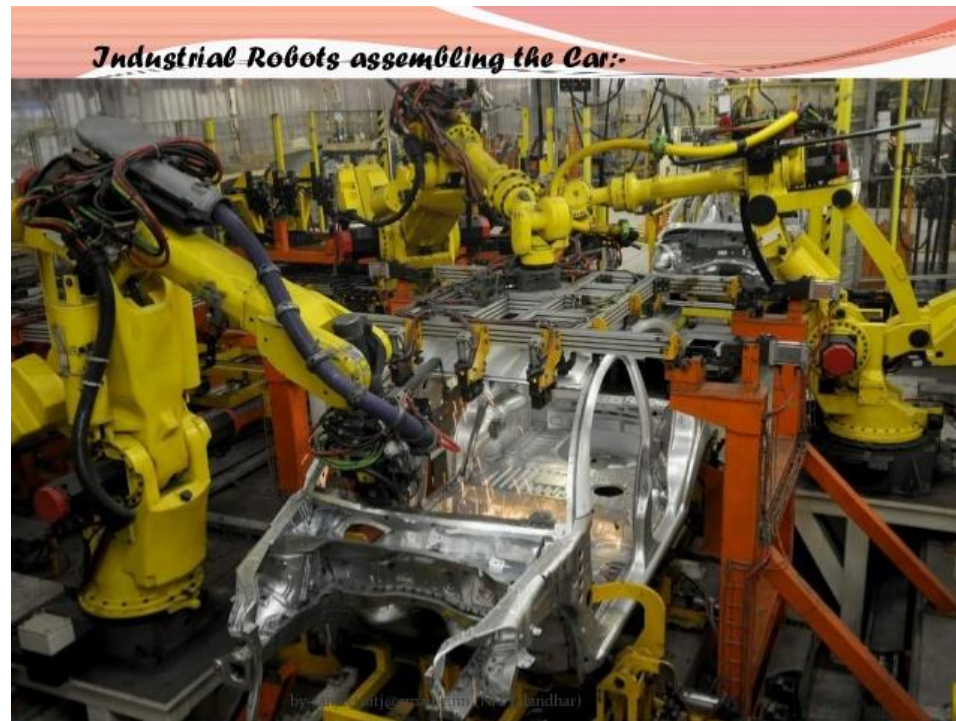


Atlas Robot

**The Humanoid
Robot**



Control and Automation in Manufacturing



Global Impact of the Revolution

- ▶ The impact of the fourth revolution on the global economy will be;
- ▶ The polarisation of labour as low skilled jobs will be automated and the same spreading to middle class jobs. This revolution could yield greater inequality, particularly in its potential to disrupt labour markets.
- ▶ This automation as it substitutes for labour across the entire country might exacerbate the gap between returns to capital and labour. Yet, it is also possible, with the creation of more highly skilled labour-force, this displacement might result in a net increase in safe and rewarding jobs.

Global Impact of the Revolution

- ▶ Hence, flexibility will be key to success; economies with the most flexible labour markets, focussed education systems, R&D centres, good infrastructure and legal systems are the most likely beneficiaries.
- ▶ Developed countries will most likely be the winners at this stage, whereas developing economies will face greater challenges as their abundance of low skilled labour ceases to be an advantage and becomes a “head wind” restraining development; their limited infrastructure will not allow them to reap the full benefits of extreme connectivity.

Demand on Entrepreneurs & Engineers

- ▶ **The groundwork is being set for the fourth revolution with the massive interconnectivity of billions of people connected by mobile devices with unprecedented power and access to knowledge.**
- ▶ **These assets will be enhanced by the emerging technologies of artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3D Printing (additive manufacturing), nano technology, bio technology (gene editing etc.), material science, energy storage and quantum computing.**

Demand on Entrepreneurs & Engineers

- ▶ **Entrepreneurs supported by Engineers will be combining computational design, additive manufacturing, materials engineering and synthetic biology to pioneer synthesis between micro-organisms, our bodies, the products we consume and even the buildings we inhabit. But the world is on the verge of a paradigm shift.**
- ▶ **There are serious problems; climate change, global warming, sea level rise; shortage of potable water, shortages of food together with increasing demand from both population growth and improving taste, need for the creation of a higher skilled population, need to transform energy use away from fossil fuels etc. – all presenting opportunities for engineers to use the emerging tools of the fourth revolution in their solutions.**

Highly Skilled vs. Low Skilled

- ▶ In T&T we cannot produce all that we require to live hence we need to participate in global trade; we need to export products and services that are globally competitive. And we need to be innovative.
- ▶ Hence, the intense automation will put a heavy demand on high skill/high paid segments of the market and such skills moreso than capital will be the critical factor of production- talent will be in continuous demand.
- ▶ Hence the largest beneficiaries of innovation will be the providers of intellectual and physical capital- the innovators, the shareholders and investors.

Innovation

- ▶ There are two approaches to building innovative products and services. One is to engage in the creation of knowledge and hence a new technology or its advancement. **We addressed this in a paper to SALISES, “Sustainable Development in T&T and the Caribbean”**
- ▶ The other is to use new and disruptive technologies to do existing things better or to offer new products and services.
- ▶ The latter of these is really about new business process innovation that utilises the new and disruptive technologies in which novelty, the innovation, is the application that either does existing things more efficiently or effectively, or does new things.

Business Process Innovation

- ▶ **These fourth revolution technologies are having a major impact on global business.**
- ▶ **Business process innovation using these technologies can give results much quicker than by creating new technologies.**
- ▶ **Hence we can use the new technologies to respond more quickly to the loss of foreign exchange income from the energy sector. Note though, that the IP of these innovations is difficult to protect.**

Opportunities

- ▶ **Two general areas of new manufacturing technologies are Additive Manufacturing (3D manufacturing) and Flexible Manufacturing (Robotics/Artificial Intelligence)**
- ▶ **The advantages of these are increased speed to market, smaller runs, customer engagement, build to order and after sales service.**

The T&T Environment- Manufacturing and Processing

- ▶ Small countries have traditionally been advised to develop its export sector via the areas of services as opposed to manufacturing, since for cost efficiency and effectiveness the latter was tied to mass production, economies of scale.
- ▶ However, the new technologies of the fourth revolution offer both flexible and additive manufacturing together with the customerisation through the immense connectivity with customers and even the merging of manufacturing with service provision.

Flexibility

- ▶ To get any of this done it will be necessary to train highly skilled staff and offer such a training/ demonstration/ consulting facility to support existing and potential manufacturers.
- ▶ Thus, it is recommended that government provides a Centre of Excellence in Advanced Manufacturing. This is surely a way to develop very quickly globally competitive ideas via business process innovation- i.e. in the short term innovative products and services can jump start our global export thrust.

An Emerging Technology

- ▶ **After some years of research Dr Defour was able to patent a new method to control Brushless DC motors that substantially improves their performance and efficiency- the technique utilises the digital technologies of the ensuing revolution.**
- ▶ **Indeed his patent heralded an emerging and disruptive technology that other innovators can use in existing and new application areas for quick commercial wins as being suggested in this paper.**

The G-Pan and the PHI

- ▶ **Two other patents were won by another colleague, G-Pan and the PHI, Professor Copeland**
- ▶ **Again because of the lack of an innovation system these patents have not been exploited though the potential of both have been demonstrated.**

Innovation G-Pan



Innovation G-Pan



Innovation The PHI



Innovation by Cash Flow

- ▶ **Another of the authors, Professor King, spun out an SME into the local private sector. To date that company has its own copyrighted systems (software cannot be patented in T&T) installed in the energy sector, the power and telecommunications utilities.**
- ▶ **The problem again is the lack of risk funding and the growth of the company has been constrained since it tries to innovate on cash flow.**

A National Innovation System

- ▶ **The Triple Helix model by Etzkowitz and Leydesdorff is the basis of the innovation system recommended by the authors**
- ▶ **The Triple Helix is an integration of three players; private sector, R&D institutions and the government**
- ▶ **The derived model being recommended is termed The Innovation Diamond**

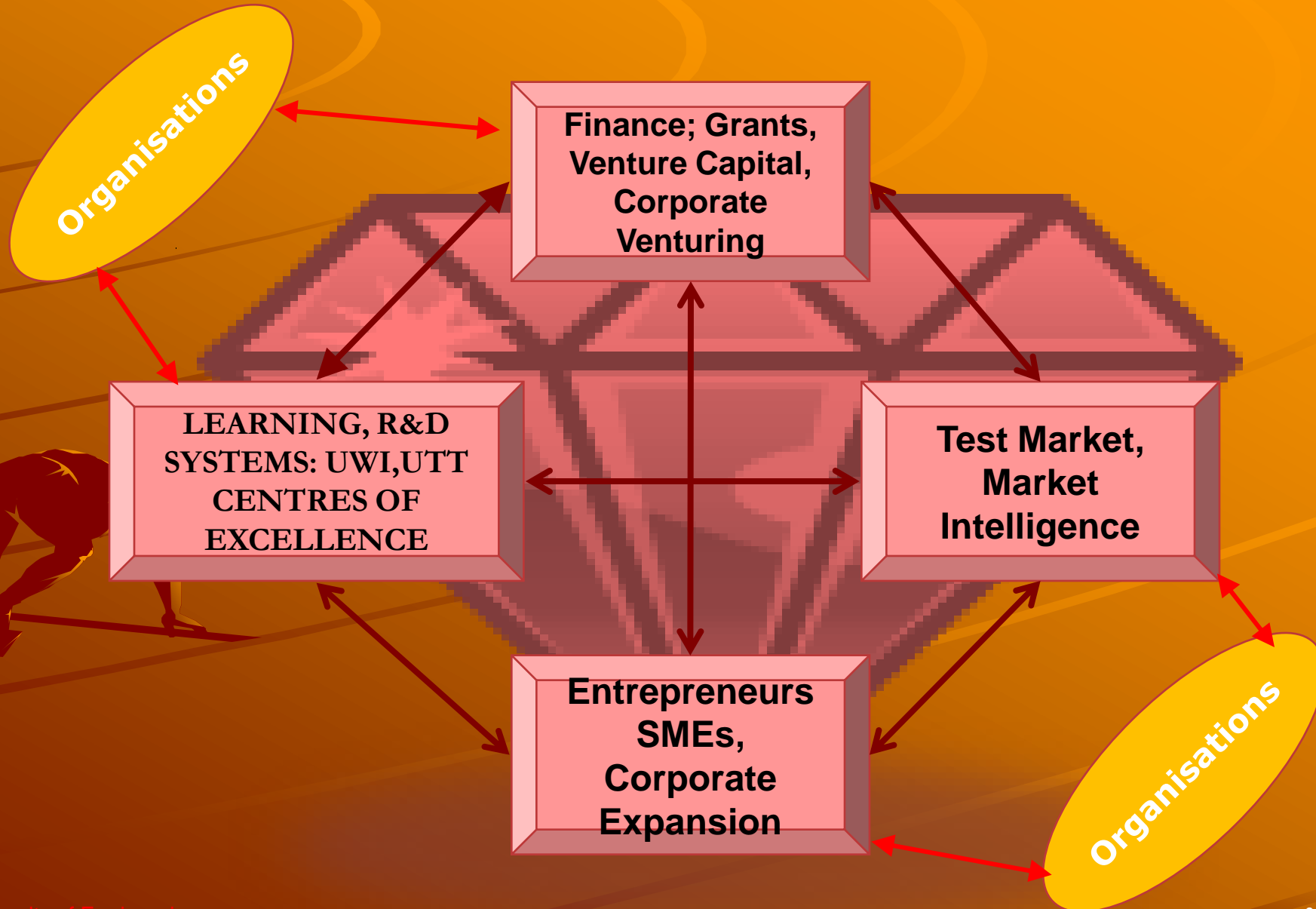
The Innovation Diamond

- ▶ **The Diamond follows the Triple Helix, though some fundamental modifications were made**
- ▶ **The first is the private sector/country's finance system is risk averse. Hence government has to assume the role of financier, venture capitalist of last resort.**
- ▶ **The government recoups its investment (financed in the first instance by bonds even the HSF) on the sale of successful companies on the stock market.**

Innovation Diamond (2)

- ▶ **The current private sector has little interest in R&D generated innovation or innovative start-ups.**
- ▶ **Hence an embryonic private sector has to be established in the first instance by the same inventors/innovators into clusters chosen by foresighting.**
- ▶ **The prospective innovators have to also be trained as entrepreneurs in business techniques**
- ▶ **The Diamond then has to have institutions that facilitate the R&D institutions (Centres of Excellence) in Finance and marketing and Market Development**

The Innovation Diamond





Thank you

Maybe we will adjust in time