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How Emerging Economies can benefit from Innovations – Education, Collaboration and Leapfrogging

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Innovation and business country culture in relation to the development and success of STPs

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Executive Summary

This paper reflects concepts based on the authors' experiences and observations to improve the innovative and entrepreneurial environment in Finland and Namibia, respectively. We take a constructive approach to bridging the gap between developing and developed economies with a focus on three approaches:

1) Foster coexistence and cooperation of industry and academia in real projects providing a stimulating atmosphere where all parties benefit. The means of choice are innovation centers, where active dialogue, information exchange and project cooperation strengthen the innovative and entrepreneurial spirit of students.
2) Encourage regional centers to identify their potential strengths and make the experts and regions cooperate in a focused way to reach the commonly set goals. The objective is to counter the tendency which affects particularly sparsely populated countries, of people moving to cities thus relegating the countryside to under-development. A model initiative in this respect has become the regional Centers of Expertise Programme, which has been successfully applied in Finland.
3) Provide the new and low-cost infrastructure needed to communicate, run small businesses, support education and provide other needed services in remote locations. This measure requires leapfrogging to the digital wireless environment.

Key Words:

Artemis Orchestra
Innovation Centres
Developed Countries
Developing Countries
Leapfrogging
Regional Centres of Expertise
Science Parks
Technology

Introduction

Finland - a developed country - and Namibia - a developing country - are small countries on the world scale. Both countries are sparsely populated, with Namibia having more than twice the area of Finland, but only 40% (2.2 million) of Finland's population (5.3 million). Both countries are fairly well-endowed with natural resources: Namibia has minerals and lot of sand; Finland has forests and a lot of snow. These two countries have a long history of friendly relations, which can now be turned into a model for development partnerships.

The minerals sector in Namibia brings about 50% of foreign exchange earnings but employs only about 3% of the population. About half of the population lives from small scale farming and on less than $2 per day[1]. There are about 2.5 billion people in the world at this income level. The challenge for Namibia now is to transform its education system and minerals-based economy into a knowledge-based economy. On the other hand, Finland has been for decades transforming its industrial base from forest-based industries to a balanced portfolio of manufacturing, ICT and forest industries. Investments in education and innovation environment are yielding good returns and Finland ranks as gold medalist in many international studies on competitiveness, innovation, industry-academia cooperation and educational system.

The reasoning is as follows: Firstly, improving a nation's knowledge base, general infrastructure or industrial structure requires a consistent long-term commitment. In the case of a small country selecting the focus areas is critical. Visible signs of progress can only be seen after about ten years of continuous investment in the selected activities, for investing in the knowledge base or competitiveness has a certain analogy to compounded interest calculation in the financial world.

An appropriate formula that we borrow from scientists and economists illustrates the effect of consistent investment in competitiveness: Let us assume that over several years we are able to maintain a constant X% improvement over our peer group or other reference point. Then after Y years this results in 100% improvement. For practical values of X% Y can be approximately calculated as Y = 70/X. For instance if by consistent actions a nation is able to improve its knowledge base by 5% per annum then after about 14 years the nation's knowledge base would be twice as good. However, when talking about competitiveness of nations it is important to remember that the reference point also changes over time. We need to look at relative competitiveness or improvements. Yet under relative measures only a few percentages over several years translate into a big difference.

Secondly, national dialogue, information exchange and project cooperation between educational institutions and industry are means to strengthen the innovative and entrepreneurial spirit of academia and students. Innovation centers, where industry and academia co-exist and cooperate in real projects, provide a stimulating atmosphere where all parties benefit through streamlining and economies of scale. Innovation centres or science parks, as well as the regional Centers of Expertise Programme (CEP), have been successfully applied in Finland. The aim of the CEP programme has been to encourage the regional centers to identify their potential strengths and make the region cooperate in a focused way to reach the commonly set goals. The successes of the Finnish science parks and CEP are excellent lessons on how to revolutionalise the knowledge base and the economy. Indeed, it is a model to be fully explored by small developing countries, and we believe the same goals can be achieved when talent is concentrated, directed and incentivized in a centre of specialization or excellence or expertise. Consequently, the Polytechnic of Namibia is now embarking on the creation of a national innovation centre/science park.

[1] CIA World Factbook, www.cia.org

Thirdly, the world is increasingly becoming a knowledge-based environment, in which systems are driven by technology. In order to have meaningful development and a stake in the world economy, developing nations must look for new and better ways of local and global engagement. We therefore recommend leapfrogging into the digital wireless environment, through sustained development policies and systems, such as institutions, low-cost infrastructure, etc.

1. Creating an Innovative Mindset and Entrepreneurial Spirit

In the first instance, it is of importance to understand the new world in terms of its development paradigms. James Martin succinctly summarizes it in his book, *The Meaning of the 21st Century*. In his first Chapter, *The Transition Generation*, he states: *"At the start of the 21st century, humankind finds itself on a non-sustainable course – a course that, unless it is changed, will lead to catastrophes of awesome consequences…. At the same time, we are unlocking formidable new capabilities that could lead to much more exciting lives and glorious victory"*[2]. In other words, development is about the big issues that will make the difference - large-scale trends, and the types of leverage that will enable us to make significant changes.

Thus the essence of creating innovative and entrepreneurial mindsets and spirit is to enhance the individual's conscientiousness and productivity, especially among the youth. Everybody can be innovative within his/her 'appropriate' context. The number of people worldwide aged 12-24 has reached 1.3 billion, the largest in history, and the majority is residing in developing countries. Because labour is the main asset of the poor, making it more productive is the best way to reduce poverty. This presents many challenges and more rewards if policies and institutions for the next generation of workers are well developed and implemented[3]. Innovations can be small improvements to quite ordinary daily routines or stem from leading edge research results. Regardless of their scope or impact, innovations give a positive satisfying feeling of achievement. Both education and a stimulating atmosphere have a strong influence or impact on innovative mindset and entrepreneurship. Innovation centres and science parks are thus good examples of a stimulating atmosphere, for once a critical mass has been achieved in an environment, success stories tend to follow each other. In other words, these must become critical high-momentum trends, needing a very high level of integrated scholarship.

Today, industries are becoming more and more knowledge based and engineering and business schools have to teach the fundamental and scientific foundations of the disciplines and instill a learning culture through appropriate skills in order to provide them a basis for continuous learning during the working life, thus broadening opportunities, enhancing capabilities and offering second chances. It is highly desirable if the education system nurtures and encourages students to start their own companies[4]. In this context, close cooperation and dialogue between educational institutes and enterprises is of great advantage. The motivation to learn and to do research increases with the knowledge such that the areas of teaching and research have explicit relevance to the industry.

Often the negative perceptions concerning cooperation with industry from the university's side, based especially on the fear that they become less academic, or the industry with its

[2] James Martin, *The Meaning of the 21st Century, Eden Project Books, 2006, p. 3.*

[3] World Development Report 2007, *Development and the Next Generation,* p. xi.

[4] Y. Neuvo: Industry Needs Universities and Vice Versa, *University in the Marketplace*, 2008 in print.

financial resources could oblige the university to serve industry's short-term needs and thus cause it to lose interest and capability to conduct longer term knowledge build-up through its own research and research cooperation. However, active dialog with industry can help the university to guide its education and research activities appropriately, without diminishing the theoretical foundations. There is evidence that good research problems can be extracted from the industry, the former which are often hiding behind the rule of thumb practices used in a company. The creation of a solid underlying theory can be enormously valuable for the company and a valuable research contribution as well. For instance, replacing a tedious optimization task with a set of analytic expressions characterizing the problem and giving the optimal solution helps the design work and possibly opens up new avenues for development. There is no doubt that industry-academia cooperation benefits both parties[5].

In addition to theoretical knowledge, industrial projects require teamwork through the acquisition and application of "soft skills", and typically have extremely tight schedules. The required applicable skills can be taught in student projects where the task is to design and possibly make a demonstrator product using currently available components and design tools. The demonstrators can be quite innovative and radical. Student projects easily get the attention of the media and thus positively increase the public knowledge of the university, a process yet to be well enhanced and entrenched in developing countries. This is quite important especially for the engineering schools as they are fiercely competing for best students with "softer" fields of education.

A very competitive but successful way to run student projects is by participating in international design contests in which there is a wide variety of projects to choose or present. Typically the task is to build an intelligent machine or robot that performs a given task. These contests are designed to encourage innovation and they definitely give the students a hands-on experience of modern technology. These contests are excellent means to teach teamwork and project management. If one misses the contest date by one day the game is over for that year. In the Artemis Orchestra[6] contest the task is to build an embedded computer system (a special kind of computer-controlled machine) that can autonomously play a musical instrument of choice. In addition to the quality of the music played, low costing is one of the design constraints. The rules encourage young students to participate. Ultimately the objective is to create a full orchestra composed of mechanical players.

For an engineering and business school, active cooperation with industry is highly important. This improves the relevance of teaching and has positive impact on the entrepreneurial skill of the students. Having student projects as formal courses in the curriculum is an excellent way to teach teamwork and learn to innovate. This may be facilitated by innovation centres. In Namibia the idea of an innovation centre has been proposed by the Polytechnic of Namibia – which has business, engineering and technology schools - with the support of the Finnish government and Finland's Technopolis. The innovation centre is being designed with the purpose of being an educational environment which blends academia with industry and provides a platform for business incubation and anchoring, research and technological discoveries. The objective is to provide the environment where students are exposed to the business world through multi-disciplinarity, project management and teamwork already during their period of study under the guidance of academics and industry. This complex environment lowers the barrier to understanding business and to start an own enterprise and also provides security where students can take risks and test even radical business ideas or product concepts.

[5] Y. Neuvo: Industry Needs Universities and Vice Versa, *University in the Marketplace*, 2008 in print.

[6] Artemis Orchestra, www.artemisia-association.org

Indeed, this is only possible to sustain if the academic institutions are sound, creative and competitive to manage the challenge-opportunity nexus successfully. The understanding by all stakeholders – academic institutions, industry and government – must be to enhance the intellectual capacity of the community and thus to improve the quality of life, provide employment and spur economic growth.

2. Shared Strategy and Focused Actions

In 2008, half of the world's population resides in urban areas and there is still a strong pull toward cities globally. In developing and sparsely populated countries there is a tendency for people to move or to live in and around cities, thereby creating *shantytowns* (or *shantycities*). This often creates socio-economic problems as cities cannot cope with population explosion and high demand for larger and expanded and more sophisticated infrastructure and economic activity. At the same time, the de-population of rural areas leads to under- or lesser-development in those areas. This is a phenomenon which occurs naturally everywhere and it is estimated that by 2030, half of Africa's population will become urban. In short, *shantytowns* have been identified as a mega-problem[7].

For example, Namibia's capital, Windhoek, has attracted people from rural areas but is not able to support decent living to the mainly uneducated and unemployed who migrate to the cities in search of better opportunities. Thus a multitude of shared strategies and measures, and focused action are needed to manage the development paradigm in Africa, as positive results are measurable only after years of continuous actions involving both the public authorities, private sector and civic society. It is important to point out that the issue *"about the 'successful' countries economically is not so much about natural resources, but about the spirit of entrepreneurship, risk and energy[8]"*. Therefore building institutions and economies is firstly a matter of human capital, meaning that capacity building should be the first priority in national development. This should not be confused with a mere high literacy rate. The idea of innovation is of prime importance for the essence of business or economy is to transform an idea into a socially and economically valued product or service. And this must be managed with the full realization of "*cultural relevance: … each country has its own preoccupations and needs, usually born out of its particular history and current circumstances"*[9].

Obviously there is no simple solution to alleviate the challenge of under-development, but there are working examples. In Finland people also tend to move to the most southern regions close to Helsinki. This causes smaller regional centers to suffer from under- or lesser development. The Finnish Centres of Expertise Programme (CEP)[10] has been quite successful in creating a new kind of cooperation among the regional players. Science parks played and continue to play an important role in the implementation of this programme.

The programme was launched in 1994 in eight different Centres of Expertise, and due to its subsequent success the government decided to extend the programme to cover 22 Centres of Expertise covering 45 fields of expertise. Competitive tendering is a central aspect of the realization of the CEP. Appointment to the programme requires a cluster of expertise that

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[7] James Martin, *The Meaning of the 21st Century*, Eden Project Books, 2006, p. 31.

[8] Arthur Gerstenfeld, Raphael J. Njoroge, *Africa the Next Decade*, Business Books International, 2005, p.174.

[9] Arthur Gerstenfeld, Raphael J. Njoroge, *Africa the Next Decade*, Business Books International, 2005, p. 168.

[10] Centre of Expertise Programme, www.oske.net/en/

has a high potential of success in that region and already represents leading edge in its field in Finland. Only the best regional programmes have been granted a Centre of Expertise status. The Centres of Expertise (COEs) compete for the basic funding granted by the state on an annual basis, as the continuing of development work in the Centres of Expertise is dependent on this funding. The amount of basic state funding handed out to the Centres of Expertise totaled approximately €8 million (Euro) in 2003 per centre. The total funding volume of the projects launched by the Centres between 1999 and 2002 was €330 million.

The CEP has made the economic structure of the regions more diverse: between 1999 and 2002, approximately 900 projects took place under the aegis of the programme. The projects dealt with both the modernization of traditional fields and the creation of new areas of growth. The immediate effect on employment of the projects that were realized in connection with the programme was significant: 5 700 new jobs mainly related to top-level expertise were created and 316 new companies were founded. The level of expertise in the fields covered by the programme as well as the level of technology has increased and the ability of the regions to make use of the research and development funding has been enhanced. The 1 400 new products, services and operational models that have been created in response to the activities of COEs are also evident to the extent that the Centres have increasingly adopted the role of innovator. The modernization of the production structure in the regions and the structural diversification of the economy are the most significant long-term effects.

Programmes at the COEs are realized through strong cooperation between the local companies, cities, polytechnics, technology centers, research institutions and other publicly administered regional bodies. The principal projects, which are significant from the point of view of regional development, and which are realized in connection with the programme, represent the most important part of that cooperation. It is essential that the participating bodies commit themselves actively to achieving the specified programme objectives.

The projects that are realized in connection with the programme are based on the development needs and capacities of companies and the innovation system, which naturally vary from one region to another. In addition, the fields of expertise differ in the phases of their life cycle and therefore different Centres of Expertise face different challenges and opportunities. The central point of departure, however, remains the strengthening of regional cooperation between companies and the education sector. Synergy and joint projects that aim at developing the innovation environment help to create better prerequisites for the growth of business activities in existing companies and the founding of new companies.

The positive results obtained during 1994-2006 encouraged the government to start the next phase of the programme which covers the period 2007-2013. The fundamentals of the new programme are adopted from the first phase. This is important as only consistent long-term actions bring good results. However, some new elements have been adapted. The two most important are the requirement for the regional centers of expertise to form cooperating clusters and the increased emphasis on international cooperation.

This phenomenal success serves as a learning model for developing countries. The same goal can be achieved in developing countries by doing the following: a) encouraging return of talent to the homeland by creating special incentives and prestige; b) concentrating the talent in creative innovative environments, e.g. centres of excellence or expertise and universities; c) connecting universities, industry, government meaningfully to create prestigious innovation centres or centres of excellence; and d) connecting local experts and

centres of excellence to the international community.

In considering development impact, it should be remembered that institutions matter most[11]. And each solution should be considered in totality rather than as isolated projects, and homogeneity must be extracted from heterogeneity.

3. Leapfrogging Technologies

Half of the world's population has no telephone connectivity and a third has never made a phone call. The International Telecommunication Union (ITU) estimates that 800,000 villages, 30% of all villages worldwide lack even basic telephony services[12]. The need development and communication for all countries has been expressed in the United Nations Millennium Development Goals (MDGs) and Universal Access. Communication is becoming more and more important as the world is globalizing, and those who are not connected now will need to be connected in the near future, as the need arises and as the technology is becoming accessible and affordable, such as cellular technology. The United Nations Development Programme (UNDP) reports that by 2001, mobile subscriber numbers had overtaken those of fixed lines, making Africa the first region of the world to achieve this[13]. Indeed, by 2004 the growth of cellular phones in several sub-Saharan African countries exceeded 150%.[14]

Moore's law, depicting the exponential performance increase of microelectronics, has been in effect already over four decades. During the last decade a parallel and at least equally important development has taken place: the birth of global affordable wireless telephony and high speed global data networks. Unfortunately, the expansion of ICT is dynamically on a market-driven basis, and thus many areas – particularly the rural and urban poor – often remain under-served. By the end of this decade we will have about four billion people using cellular telephones. The use of Internet is also in the billions range. Voice-over-Internet enables extremely low cost telephony independent of distance and the cost of an email does not depend on the size of the mail or on the distance it travels. Today, each person sends more than 1 500 *e*-mails per year. It should be mentioned that due to modern telecommunications, geography is no more the major obstacle to global human interaction. However, this is only the beginning as the cost of telecommunications and computing will continue to decline. In addition, the use of Open Source software and related technologies offer many benefits in terms of affordability and innovation, and improvement in community development as a networked society. The world continues to shrink and astonishing new services will emerge following the trend set by Google, Skype, Wikipedia and many others.

Consequentially, it is essential for both developed and developing countries to take full benefit of the wide range of opportunities the modern Information and Communications Technologies (ICT) provide. ICT can provide community services, quality education and enable business innovations almost equally well in remote locations as in big cities. In emerging economies there is the interesting possibility to leapfrog some of the technologies used today by developed nations.

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[11] *The Economist*, 5-11 October, 2002, p. 291.

[12] *Community-based Networks and Innovative Technologies: New Models to Serve and Empower the Poor*, UNDP, 2005, p. 5.

[13] *Community-based Networks and Innovative Technologies: New Models to Serve and Empower the Poor*, UNDP, 2005, p.15.

[14] Arthur Gerstenfeld, Raphael J. Njoroge, *Africa the Next Decade*, Business Books International, 2005, p.170.

Interesting opportunities are especially arising from the use of wireless communication technologies. Owning a mobile phone is today becoming affordable for people with daily income in the $2-4 range and there is a continuous push to further lower the cost of the service. As *The Economist* stated: *"Encouraging the spread of mobile communications is the most sensible and effective response to the digital divide*[15]*"*. Modern smart phones have the computing performance of a few years old PCs and they provide convenient wireless *e*-mail and Internet services. Mobile internet enables establishing businesses also in remote locations, tourism being a good example. Namibia has taken a positive step into the future by providing cellular-based high speed packet data services in urban areas. This is a service that many of the more developed countries have not yet deployed. Last year in Namibia the main author experienced 765 kbits/s end-to-end data rate while downloading emails from Finland, and most likely the limiting factor for the speed was not the local cellular network in Windhoek. *The Economist* further states wisely: "*There is no question that the PC has democratised computing and unleashed innovation; but it is the mobile phone that now seems most likely to carry the dream of the "personal computer" to its conclusion"*[16].

The One Laptop per Child[17] program has received a lot of positive global attention and is definitely worth all the support and excitement it has received. However, as a complementary action we strongly urge leapfrogging to extensive use of cellular phones and mobile internet in the rural areas. As a maturing and low-cost technology this can be deployed already easily today. Mobile internet brings immediate benefits to the rural families by providing the connectivity needed to take care of many daily errands and to provide many of the needed services, like (*e*-)mail, in a fast and convenient way. It also is a critical enabler for running local businesses like specialised programs for nature-loving tourists.

Wireless downloading of school books to a paper-looking electronic display is an attractive way to modernise the school library and to expand its size enormously. The marginal cost of night time downloading of large amounts of data is quite low as electricity for these devices can come from solar cells, and in countries like Namibia such a platform is highly practical and useful already, and reduces the dependency on scarce and expensive traditional sources of electricity. The power consumption of smart phones is already quite small and continues to decrease. The paper-sized displays are passive in the sense that power is consumed only when the pages are "turned". The opportunities of the mobile internet can provide can go on forever. The point we are making is that these options are real and actions can commence today. Indeed, such initiatives can result in new models to serve and empower the poor through community-based networks and innovative technologies. These include community ownership and development, wireless networks and technologies and technology combinations.

Conclusion

In this paper we have outlined three approaches to improve the innovation capabilities of a nation, which are all located at different levels: one at the educational institute level, one at the regional authorities level, and one at the national level. Successful implementation of each approach requires support and participation from all these levels.

[15] *The Economist*, March 2005.

[16] *The Economist*, July 2006.

[17] One Laptop per Child, www.olpc.com

In educational institutions, entrepreneurship and innovation are best learned in an environment where these activities are taking place in close proximity to the students and industry, respectively. The innovation center idea brings these values essentially inside the campus. Thus encouraging students to participate in technology contests and other construction projects is an excellent way to teach innovation and teamwork in engineering schools.

To make a noticeable improvement on any region's innovation and entrepreneurial capabilities requires set goals and strategies, and a long-term commitment. Signs of progress can be visible in five years time but to get real changes in place ten years are needed. This calls for a region to have a shared strategy and commitment from all relevant players. In order to obtain good results the regional players have to select focal areas for action. The management of the regional programme has to be of high quality, for experience from the Center of Excellence Programme tells us that a strong and broad regional commitment and good programme management are characteristics of best programmes.

Finally, information and communication technologies will continue to change the world dramatically in the forthcoming decades. Technology leapfrogging especially in wireless areas is an interesting possibility for emerging economies. Mobile internet along with widespread deployment of mobile telephony brings many of the needed community services to rural areas. This helps in keeping the rural areas inhabited and supports local entrepreneurship and development. Most of the needed technologies already exist and many interesting technologies are just behind the corner. However, a leapfrogging plan still requires careful planning and execution. A possible way to gain experiences is to initiate a smaller scale experimental project and to collaborate with world leaders.

Overall, the foregoing concepts have been explored, tested or executed in developed and developing countries. What is required is a meaningful partnership or engagement between the different players – academic institutions, business and government – in order to have a meaningful undertaking to carry out the projects successfully.