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A Network for Sustainable Innovation in Africa

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A Network for Sustainable Innovation in Africa

Abstract

A major challenge for industry in Africa is to innovate: initiate, or adapt fast enough to changes in the economic and commercial business environment. Doing this in a sustainable way means catering to human needs while maintaining the environmental and natural resources and local communities as a long term pre-condition for human societies.

The relevance of successful and flexible innovative capabilities among industry, knowledge institutes, non-governmental organisations and governments is directly related to this challenge. Key topics are product innovation, process innovation and organizational innovation.
The United Nations Industry Development Organisation (UNIDO) together with leading universities in Africa and Europe is initiating a network on industrial innovation as a vehicle to create a substantial capacity in African countries, both in academia and in industry, for supporting the current and raising the next generation of industrial innovators.

In a consultative round with the participating universities the needs and opportunities in this area were assessed. Next, a more specific action plan was developed in April 2007 during a joint expert group meeting. A support package is being developed and end of 2007, 50 practical university-industry cooperation projects on sustainable innovation will be started.
Parallel to these activities, funding by private sector, bilateral donors and EU will be secured.
The network is envisioned to grow into a global network between at least 300 universities in 2013.

Key Words: *Industrial innovation, Design for Sustainability, Africa, Network, Competitiveness.*

Introduction

The importance of innovation and of national, regional or sub-regional innovation systems for the future of industrial development is extensively detailed in UNIDO publications (UNIDO, 2002, 2005). The structure of innovation systems, and the different ways in which these can be transformed and improved according to the demands for competitiveness, are here in-depth elaborated. Most recently, the Assembly of the African Union in its eight ordinary session of 29-30 Jan. 2007 specifically "…strongly urges Member States to …develop innovation strategies for wealth creation and economic development", and refers to a 1% GDP target by 2010[1] as agreed by the Khartoum Decision (EX.CL/Dec.254(VIII)), and further in the Addis Ababa Declaration[2] commits itself to "promote and support research and innovation activities and the human and institutional capacities" and calls on bilateral and multilateral organizations to support the Member States to implement the decision on Science and Technology. The Consolidated Plan of Action form the New Partnership for African's Development (NEPAD) (NEPAD 2006) underlines the necessity for Innovation extensively.
The United Nations Millennium Project (UN, 2005) dedicated a specific task force on Science, Technology, and Innovation, reporting on the necessity to develop national systems of innovation, and indicated the vital role that Universities can play. The Commission of the European Communities in its proposal for an innovation strategy for the EU, acknowledges the basic necessity of obtaining a clear picture of innovation performance in order to monitor progress and to set policy and strategy for further development. The United Nations University Institute for New Technologies (INTECH) has further studied the importance of National Innovation Systems, and specifically the necessity to adapt the models that such systems may follow to the specific requirements of developing countries, e.g. one

[1] Assembly/AU/Dec.161 (VIII)
[2] Assembly/AU/Decl.5(VIII) Addis Ababa Declaration on Science, Technology and Scientific Research for Development

approach doesn't fit all (Gu, 1999). This is a point of view more extensively elaborated by the World Bank Institute in its conceptual framework on Promoting Innovation in Developing countries (aubert, 2004) where specific distinctions are made for strategies that can be adopted by countries, dependent on their respective level of income (low, medium, high, or multi level situations).

To support the above developments, three European universities (Delft UT, Politechnico Milano, TU Graz) have approached UNIDO with a proposal to establish a network of universities and university chairs, which would address the Industrial human resources requirements in innovation, and would carry out industry – university cooperation projects that bring direct benefit to industrial enterprises. UNIDO recognized the importance of re-building university curriculums to better suit the requirements of industry, and realizes that practical cooperation of industry with universities constitutes an essential element hereof.

The programme foresees to establish Chairs on Innovation, e.g. full- or part-time professorships, that will introduce UNIDO supported methods on Innovation in university curricula and would work together with industrial enterprises on innovation projects. By direct involvement in industry projects, both students and university staff will be more exposed to hands-on Innovation work, the experience of which will benefit the quality and societal relevance of university curricula. For industry, the cooperation will give access to the scientific knowledge of the network, as well as more interaction with young professionals.
Based on these experiences of carrying out innovation in Industry, the Chairs will give feedback through a UNIDO Consultative Committee on Innovation and Innovation Systems, which will reflect these findings in regular global forum publications.
The network is foreseen to be global, assuring that each member state is supported in building effective human resources in Innovation, involving 300 universities by the year 2013. A first phase with 10-15 universities from Africa has recently been initiated.

Background

The problem addressed is the low and slow rate of innovation in industry in developing economies and economies in transition.
Associated adverse effects are reflected in for instance high failure rates of innovations and consequent loss of capital and other opportunities, loss of competitive position and consequent loss of employment, and inefficiencies in resource utilization. The last point carries specific long lasting consequences, as products that are not optimally designed will have unnecessary environmental adverse impacts during their use and after disposal, a fact that is specifically addressed in product/service innovations following Design for Sustainability concepts (Crul and Diehl, 2006).

The herewith-related problem is the inadequate knowledge and insight into the factors and circumstances determining the success rate of innovations in the productive sector. The character of that knowledge, however, is such that largely it has to be developed locally, trough practice and experience. The situation is complex due to the competitive pressures of globalization, environmental constraints, and trends in technology development.

The problem is further compounded by the fact that is takes a much longer period to assure that the type of knowledge gained by experience is shared by a large number of individuals in order to have a non-marginal impact, as compared with technical 'documented' knowledge.

The main areas where applied science and technology combined with local, multidisciplinary approaches would be needed are most likely linked to Basic Development Needs in most of the African setting, e.g. Agro food, Energy, Water and Sanitation, Housing, Transport, and ICT.

The Organisation for Economic Co-operation and Development (OECD) in their most recent and updated guidelines make specific distinction between product innovations, process innovations, marketing innovations and organizational innovations, and define an innovation as:

"the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations" (OECD 2005).

To appreciate the character of the problem issue, e.g. the strategy options for increasing success rates of innovation in the productive sector, one has to realize that the impact and success of innovations is now generally accepted as resulting from the actions of the innovating entity, (company or organization, cluster, association, etc) and the larger context in which such innovations take place. The impact of a desired innovation by an actor consequently depends on the ability to interact with its surrounding context for knowledge, support, facilitation, allowance and legal protection. Specifically, Innovation cooperation with Universities has become in industrialized countries an essential part of Innovation in Industry.

The above gives ground to two types of knowledge requirements:

1. related to the innovation itself (which could be product or service, process, market or organizational innovation) and
2. related to the context of the innovating actor, e.g. the innovation system.

The first point above will require a knowledge system according to a professional model (technology transfer being a clear example) while the second point tends towards needing knowledge according to an organizational model. An OECD study (OECD, 2003) presents the two contrasting knowledge systems more in detail as follows:

Two Contrasting Knowledge Systems		
	Professional Model	Organisational Model
The knowledge base	Knowledge of rationality; Knowledge acquired by formal training; Rather abstract and theoretical, generic and specialized, highly rationalized and internally coherent; Relatively easy to diffuse, but not easy to apply to a specific practical problem, and difficult to integrate.	Knowledge of experience Knowledge acquired by action and experimentation; Embedded in specific organizational routines and procedures, understood and shared by members with common experience and values; Rather difficult to diffuse to different contexts, but more concrete, practical and integrative.
Knowledge structure and organisation	Task specific, sequential, individual based; Precise Job descriptions.	Diffuse, overlapping, group-based; Job descriptions broad and ambiguous.
Co-ordination and transfer of knowledge	Explicit and document based; Written rules, procedures and detailed specifications.	Tacit and human network based; Intensive and extensive interaction between group members.

Table 1: Two contrasting Knowledge systems

These knowledge system characterizations fall in line with another finding of the Industrial Development Report 2005 (UNIDO 2005), listing the major components of innovation systems being business sector, business support structure, Institutions and markets, Links networks and interactions, and culture and social structure

The first three are more oriented around professional model knowledge systems, while the two last categories relate to the organizational model knowledge system.

Based on the above one can draw the following conclusions.

Innovations are introduced everywhere in the productive sector, within their context, and with a certain rate of success that is influenced by both the quality of the innovation and the way it fits the context. Their introduction does not necessarily depend on any knowledge of innovation processes or

innovation systems; they happen because of driving forces such as competition, resource scarcity or creativity.

Increasing the rate of success of innovations, however, requires managing the innovation process, as well as managing the interactions with the context in which the innovation is taking place. For such management, knowledge and knowledge development is essential. The models to describe Systems of Innovation serve to build and use such knowledge. The essential knowledge systems follow professional and organisational models that differ significantly on major points and should not be confused; most importantly, the organisational model is highly context specific. Consequently, it needs to be developed locally (national or sub-regional), and such development will be largely based on acquisition by experience, action and experimentation. Through applying organizational knowledge, innovation challenges outside the immediate control of enterprises, such as found in sustainability issues, can be successfully tackled in a way that incremental innovations inside a company or value chain can never achieve.

Increasing the rate of success of knowledge development on, and application of models to describe Systems of Innovation will require a self-reflective component, measuring the effectiveness of policies, networks, and institutions in relation to the overall innovativeness of the productive sector, and challenging the suitability of models used. This type of knowledge (on suitability of innovation system models used) will equally require a knowledge system following the organizational model, as it will be highly context / country specific, and based on experiences.

To increase the success rate of innovations in the productive sector, it is essential to develop local, embedded knowledge, based on action and experience, a knowledge that is rather difficult to transfer from elsewhere as compared with knowledge on for instance technology (although both are needed).

To enable the development of local knowledge on innovation and innovation systems, specifically according to the organizational model, and to supply the human resources trained to acquire and use such type of knowledge, intensive cooperation between academia and productive sector on innovation is essential, also in light of technology based innovations.

Network Participation and preliminary Needs Assessment

In the first phase of the network development, 12 Universities (9 from Africa, 3 from Europe) participated in the meetings:

1.	Austria,	Graz University of Technology
2.	Burkina Faso	Université Polytechnique de Bobo-Dioulasso
3.	Egypt	Heliopolis University
4.	Italy	Politecnico di Milano
5.	Kenya	University of Nairobi
6.	the Netherlands	Delft University of Technology
7.	Nigeria	University of Lagos, Akoka, Yaba
8.	Senegal	Universté de Thiés
9.	Sierra Leone	Njala University, Freetown
10.	South Africa	Tshwane University of Technology
11.	Tanzania	University of Dar es Salaam in Tanzania
12.	Zambia	The University of Zambia

It is envisioned that this group will be extended in the near future.

A number of issues can be identified as being a barriers for industrial innovation: The poor linkage between universities and industry is eminent, as is the lack of a general awareness about the need for innovation as a way of mastering change. This situation is aggravated by the lack of a research tradition, or a general lack of awareness about the research that is actually carried out, possibly due to poor publicity.

Overall, industry is acknowledged as the means to apply new or adapted technologies on a larger scale (to derive the larger scale beneficial impact to society), and, hence, the necessity of working with industry and the herewith-associated boundaries in terms of market forces and economical performance. Practically all institutions in Africa are suffering from Brain Drain issues, and are actively

looking for ways to keep talented young professionals in the country or attracting expats back to the country (brain gain).

There is a shared understanding on the need to focus on actual problems of the African continent in terms of sustainable development, which results in focus areas on water and sanitation, irrigation, renewable energy, but also new technologies such as information and communication technology.

Apart from the application field, more basic issues are the need for a culture of innovation, the importance of establishing Innovation Policies and the need to look at all aspects influencing innovation success through Systems of Innovation approaches. In that wider perspective, issues like Intellectual Property Rights (and their enforcement) would find a place, as well as provision of risk capital.

Apart from the provision of capital for innovative initiatives in industry, the need for funding of the activities of the respective universities in innovation is equally important.

Potential priority areas of cooperation or synergy are to be identified. Through limiting the areas where the network would initially facilitate university-industry projects, the potential of making full use of each other's experiences over the network in terms of technology providers, industry structure, market access, etc. can be increased.

On the basis of a simple questionnaire and a consecutive plenary consensus discussion the following broad areas have been listed as preferential.

Following the Oslo Manual (OECD 2005) typology of innovation, Product (goods and services) innovation was given the highest priority, followed by process innovation, organisational innovation and market innovation.

On the broad areas of interest the following priorities can be identified, in order of highest priority:

1. Energy, Manufacturing
2. Agro-food, Water, Health
3. New technologies, ICT

All steps of the value chain will be included, raw materials producers, components and semi-finished products, as well as final products and services.

Consolidation of the network plan

The *vision* of the Network can be described as follows:

By 2013, a *Global UNIDO Network of University Chairs on Innovation* between at least 300 Universities world wide, will be recognized by UNIDO Member States as an essential example of practicing effective Industry – University cooperation in Science and Technology. The Network will have created a non-marginal national capacity, both in academia and industry, for raising the next generation of Industrial Innovators.

The importance for successful Innovative capabilities and the flexibility herewith obtained, is directly derived from the challenge to industry to initiate, or adapt fast enough to changes in the economic and commercial business environment, in order to continue catering to human needs while maintaining the environment and natural resources as a long term pre-condition for human societies. The size of the network is based on a participation of two university per Member State, one with a technical orientation, and one with a commercial / business administration background.

The *general objectives* of the Network are:

- To increase the success rate of innovations through improvement of Industry – University cooperation to apply Science and Technology.
- To bridge the gap between the technological and human resource requirements of industry in the field of innovation on the one hand, and the academic capacities to supply these on the other.
- The ability to regularly review and update the national policies of UNIDO Member States in the field of innovation.

- To facilitate the knowledge and coordination of experiences and research in the field of Innovation Systems in developing countries and economies in transition.
- To increase the perception of Innovation and Applied Science and Technology as an instrument for supporting the sustainable growth and the alleviation of poverty

The *essential elements* that the Network would need to include to be successful can be defined as follows:

The *establishment of University Chairs*, with a mandate to promote Innovation, initiate, organize, and carry out commercially relevant innovation projects with industrial enterprises. These projects can be an initiative either from the industry partner or from the university. The examples generated by these project wills serve as stimulus for further and future industry-university cooperation.
The University Chairs will have a challenging task – they will function as a bridge to local industry, local stakeholders and foreign partners, as well as have the task to innovate the university system and be strongly involved in curriculum rebuilding programmes. Also, the Chair will be involved in the outreach programme to university alumni and professional organisations.

A *Consultative Committee* to support UNIDO's Global Forum function in the area of Innovation in Industry
The Consultative Committee should be seen as a Steering Committee organ with the mandate to provide guidance and insight on priority functions and objectives of the network, as well as guidelines on network membership, entry and exit procedures and quality assurance. The committee work will be facilitated by UNIDO through annual meetings, timed - if feasible -, in conjunction with UNIDO Policy Making Organs' meetings such as General Conference or Industrial Development Board.

Human Resources development, including curriculum rebuilding, graduate re-skilling, and secondary education programmes in creativity and collaboration.
The HR development will assure local human resources with practical experience, awareness and attitudes for innovation systems being available to industry. The Goal of HR development would be to bring the issue of Innovation in the curriculum of students and expose them to industrial problems. This would lead to an intermediate goal of assuring that Industry becomes a stakeholder in curricula development. The experience gained with the innovation project in industrial enterprises will be of specific relevance to the HR development.
This would have the following implications: Engagement of industry in the structure and contents of curricula as taught at the university premises, possibly with visiting teachers from industrial enterprises; and increasing mobility and exchange between the faculty (students and lecturers) and industry (professionals and experts) developing joint research and project.

University *Alumni and Professional Associations* outreach programme
Promotional activities with University Alumni, both from industrialized and developing economies, and specifically for CSR related activities. These activities and potential networks will be set-up to help mobilizing the private sector, including TNCs for Innovation System building.

Improved *South-South cooperation* in technology and innovation projects and programmes is also seen as an important element of the growing global network.

Next steps in Network Development

A three-tier approach for phase 1 (2007-2009) was defined to proceed with the development and establishment of the Network, focusing firstly at establishing a meaningful network between Africa and Europe with initial working contacts with Brazil reflecting the need for South-South cooperation. The approach was considered a minimal requirement that can be extended upon sourcing of additional funding.

Tier 1: Network building:
- Consolidation of overall work programme and definition of Africa-EU network
- Network meetings: high level segment / launching; Consultative Committee meeting and formation of Operational Committee
- Publicity and coordination: Web site development

Tier 2: Cooperation with Industry

Identification and formulation of 50 projects in Africa with Industrial enterprises based on master student graduation projects (EU master students twinned with African students):
Development of support and communication package,
Expert support for individual chairs in contacting local industry
Matching / twinning African Master students and European Master students
Network meetings: Identification, planning and managing of university-industry projects.

Tier 3: Funding mobilization
Dedicated presentations of network and identified industry projects to potential donors

An important activity in tier 2 is the development of a support and information package for African partner universities. The objective of this support package is to engage industry, and identify, plan and execute innovation projects in industry. This support package will be published by the end of 2007 as a UNIDO publication.

The guidance notes, demonstration material and case studies in this package will focus on the following topics:

• The communication process: involvement of partners and intermediaries, how to identify a joint innovation project based on local needs and markets, managing expectations.
• Identification and planning a project: methods for framing and scoping, intermediate steps, in substantive, budgetary, and procedural plans, Assessment of risks.
• Specifics of Identification and planning of a graduate student project that will be integrated into the company innovation project (both for European and African universities).
• Organization: Detailing the obligations of partners, financial and legal issues, exit procedures, liabilities and insurance, Health and accidents, Intellectual Property, Publications of results, Use of logo's etc.
• Managing and Control: Progress reports, Measuring performance, University credits, Baseline studies, Evaluation models and methods, Conflict resolution.
• Implications of character and substance of the innovation process: product, process, service, management or market innovations.

Examples of Sustainable Product Innovation projects

Two examples (one from Tanzania, one from Cambodia) of sustainable product innovation projects with industry are presented as examples of the type of projects that can be expected to be started by the network.

Cassave Grater, Intermech, Tanzania

Intermech Engineering Limited is a small sized company situated in Morogoro, Tanzania, offering a wide range of services from engineering design, manufacturing, machinery installation and plant commissioning (figure 1). Their main focus is the manufacturing of agro and food processing machinery and equipment by the about 10 workers in the metal workshop. Intermech is continuously developing new products to extend its product folio while meanwhile redesigning their exiting products in order to improve them.

Figure 1: Intermech Metal Workshop in Morogoro Tanzania.

Cassave is an upcoming and promising crop in Tanzania, which can be processed into starch for food purposes and as an input for the local textile industry. Intermech decided to develop a range of

products for processing the harvested cassava into high quality starch. As a first step a new cassava grater was developed. In order to develop the first model several other existing models were benchmarked by to looking at illustrations, the internet and competitors products at fairs. Based upon this benchmark a version with a wooden drum with needles was developed (see fig 2).

Figure 2: The original wooden drum with spikes and the new metal drum.

In a next step staff from the Faculty of Engineering of the local University of Dar es Salaam (UDSM) redesigned together with Intermech the first version of the cassava grater (figure 3). More than 20 serious improvement options came up to reduce the environmental impact, to increase the quality and to decrease the costs. Focus of the improvement options were the central part of the product, the wooden drum. The production of the wooden version with metal pins was very labour and cost intensive. Secondly, after intensive humidity problems arose resulting low quality processing of the cassava and short lifespan of the drums itself (which would result in high maintenance costs).

One of the outcomes of the redesign projects was the replacement of the wooden drum by one produced from cast aluminum and perforated sheet. The new metal drum:

- Has fewer parts and production operations → lower production costs;
- Use of local available materials no (import of spikes);
- Increased efficiency while processing the cassava;
- And a longer expected lifespan;
- Improved ergonomics and safety for the user.

Figure 3: Redesigned Cassave Grater

After the successful benchmark and redesign of the cassava grater, Intermech continued with developing the next product in the cassava processing line: The Starch Extractor. The prototype of the extractor (see figure 4) functions well, making it now possible to produce Cassave starch locally in stead of importing it.

Figure 4: Intermech Starch extractor

The series of projects at Intermech demonstrates that small production companies in East Africa countries do not necessary need to copy the designs of existing machines of (inter)national competition. With the implementation of the basics of the product innovation process these companies can come up with unique innovative products that are designed to fulfill the specific (local) needs. Since these products and machines are designed and manufactured in Tanzania, they meet the local circumstances (for example no running water) and demanded scale much better. Besides this, the repair and maintenance of the machines can now be executed locally.

Solar Lantern, Kamworks, Cambodia

About 90% of the Cambodian households has no access to a secure and reliable electricity infrastructure for lighting. Kamworks, a start-up solar company in collaboration with DUT considered Cambodia's problems and solar resources as an opportunity for local production of solar lighting products. The Design Brief of the project was to develop an affordable and desirable Photo Voltaic (PV) powered light device which could be produced locally.

Prior to the product development phase of the project, a 'context' field research was conducted in the rural areas of Cambodia by visiting and living with the local people. Based on the field research is was concluded that there is a need for mobile quality light, which can be used for orientation purpose to light a wide area as well as a task purpose to light a small area with a higher illumination level. People mostly use the light under the house and in this case it is desired to hang the light at the ceiling and let it shine downwards (figure 5), like in the western world most lights are fixed at ceilings. This lacking feature is one of the main complaints about the current solar lantern designs.

Figure 5: different functionalities of Kamworks Solar lantern

Visiting local workshops gained insight in the status of technical know-how and production techniques. In Cambodia a lack of production industry resulting in a lack of skilled people, resources and distribution channels with suppliers of components of the new product.

The final design was a vacuum-formed multifunctional quality lantern called Angkor Light. The design appealed to Cambodia's national symbol, the temples of Angkor. Vacuum forming is an appropriate technology for a start-up company like Kamworks. It combined the advantages of low investments and simple processes. The Angkor Light used replaceable quality electrical components. The World Bank 2006 Development Marketplace awarded Kamworks with US$174,000 for developing an innovative distribution model. Currently the production of the “Angkor light” has been started.

Closing remarks

The examples of projects given above are both the result of university-industry cooperation and would most probably not have happened without this cooperation. The input of technical and design knowledge from the university in combination with the entrepreneurial spirit and market knowledge of the enterprise can make this type of projects to a success.

In the next phases of the network development, starting 2009, the establishment and formalisation of the UNIDO Chairs system as well as the further development of the network into a global network on Industrial Innovation will be undertaken. Communication and dissemination on project results to a wider audience and involvement and cooperation with interested industry, universities and other stakeholders are an essential part of this development.

The network is an example of a joint effort from knowledge institutes, industry and national and international governmental organisation to establish bottom-up, demand-driven, locally owned innovation initiatives aiming at improvement of national and local competitiveness and sustainable industrial innovation.

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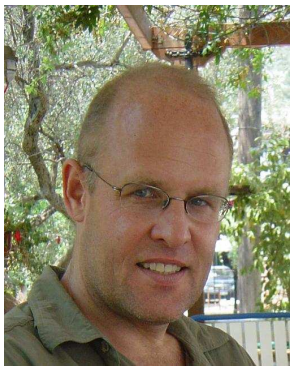

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