The Second Science with Africa Conference

Entrepreneurship Education for Scientists and Engineers in Africa: Challenges and Opportunities

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1. Introduction

“Entrepreneurs are the people who have the creative ideas, drive and determination to set up new small businesses: the seeds from which big enterprises can blossom.”

African economies have traditionally been raw materials based. This has resulted in:
- Lack of technological and industrial development.
- Lack of economic development – poverty and unemployment.

STI development is natural outcome of value added processing of raw materials – leading to:
- Self employment opportunities through entrepreneurial ventures.

Governments have created special funds and agencies to facilitate entrepreneurship, e.g.
- CEDA, LEA in Botswana – Support all business venture types.
Educational institutions also have a role to train scientists and engineers in entrepreneurial skills.

- Innovation, generation and protection of intellectual property, and technology transfer and commercialization of inventions.
- Production, assembly, and servicing of technological consumer goods, educational and research equipment not necessarily involving IP issues.

Training needs, limitations, advantages, and disadvantages of the two models of entrepreneurship for scientist and engineers are discussed.
2. STI Infrastructure – Challenges

2.1. Tertiary Education in Science and Technology.

2.2. Research and Development Infrastructure.
2.1. Tertiary Education in Science and Technology

- **Prevailing Scenario and Challenges:**
  - Admission to tertiary programs in sciences is based on performance in the secondary/high school.
  - After a common year or two, students are designated to pursue different science disciplines.
  - Top performers are offered to study professional degree programs, e.g. medicine, IT, engineering etc. (No consideration is given for aptitude.)
  - The weakest students are left to study basic/pure/natural sciences.
Having missed opportunity for the high profile career options, science students are generally less committed and motivated, and many of them fail to perform well enough to pursue research and innovation career.

Few good performers are recruited as SDFs; others take up school teaching and Government jobs.

Government jobs have none to minimal opportunity for research and innovation.

Engineering graduates prefer employment where ample opportunities for rapid progression exist as compared to pursuing a Research & Development career.
2.2. Research and Development Infrastructure

**Inabling factors and challenges:**

- Research councils, and research and innovation infrastructure are underdeveloped or lacking.
- Due to lack of adequate equipment, research at universities is often theoretical with none or little industrial potential.
- Expatriate staff are unable to attract research funding due to short term contract employments.
- Most universities lay higher emphasis on published research for progression and contract renewal.
R & D infrastructure… (2)

- Not enough inducement for commercializable R & D and innovation where the odds of success are low.
- IP registration and patenting is a long drawn, costly process; skills and resources in most cases are lacking.
- Some universities are beginning to offer IP services which are not adequate; staff lack training/experience.
- Industrial base is weak, with nearly no in-house R&D except for the quality control activity in some cases.
- In case of a franchise, R&D, if any, is done by the parent company, generally outside the country.
Other barriers:

- In most cases precarious economic climate, and in some case uncertain political environment.
- Uncertainty of long term continuous funding for the sustenance of projects.
- Communication gap between the policy makers and the "people in the know".
- Very little science based industry.
- Lack of books, reference material; often out-dated.
- Lack of networking, collaboration, information sharing.
- Lack of awareness about knowledge based economy, technology transfer process...
3. Entrepreneurship – Opportunities

3.1. IP Generation, Commercialization and Entrepreneurship.

3.2. Non-IP Driven Entrepreneurship for Scientists and Engineers.

   (Brief comments and an Example.)
3.1. IP Generation, Commercialization and Entrepreneurship

- IoP, UK has organized three Entrepreneurship Workshops for Scientists and Engineers from Developing Countries at ICTP, Italy since 2006.
- Same or related W/shops have also been hosted in other countries; the host country bears the local costs.
- First African W/shop was held in RSA in November 2009, with the following aims and objectives:
  - To introduce the process of innovation, generation and protection of intellectual property, technology transfer and commercialization of a product.
To enable create self employment for scientists and engineers, who in turn would create job opportunities for the others.

To build capacity through the training of trainers in entrepreneurship and innovation management skills.

To encourage universities in Africa to introduce entrepreneurship and business skills in science and engineering curriculum.

To reduce brain drain by encouraging a culture of entrepreneurship among African Scientists.
To encourage interdisciplinary and multi-stakeholder dialogue through bringing together:

- Physicists, chemists, life scientists, engineers and social scientists.
- North – South cooperation: scientists from Europe working with African scientists.
- South – South cooperation: scientists from India and China working with African scientists.

Topics covered at the W/shops: IP, Patenting, Copyright, Licensing, Start-up, Spin-out, SME’s, Funding, Case studies, Business plan, Group discussions.
Follow-up Support:

- On-line discussion forum for delegates to network, share knowledge, and interact with resource persons and experts.

- On-line courses on soft skills, such as Leadership, Negotiation, Coaching, Conversation, Time management, Manager’s starter pack.

IoP W/shop is an excellent training opportunities for potential entrepreneurs. For next W/shop contact IoP, or it can be offered in any country where demand prevails; host country bears the local costs.
IP Driven Entrepreneurship… (5)

- **Entrepreneurship Curriculum by IoP, UK:**
  - A 16-week Entrepreneurship course for Scientists and Engineers is available free of cost from IoP in ready to teach Microsoft PowerPoint format.
  - The curriculum covers: IP issues, Patenting, Invention to product process, Business fundamentals, Financing, Getting started, Exit strategies etc.
  - The course has been introduced in the curriculum by over 15 universities in developing countries with or without some adaptation to meet local needs.

- **The ready to teach IoP course is an excellent training resource for potential entrepreneurs in the developing countries.**
3.2. Non-IP Driven Entrepreneurship for Scientists and Engineers

- Under prevailing scenario in S&T education, and research infrastructure in most parts of Africa, IP driven entrepreneurship has very limited potential.
- There are other scientific and technical services which are lacking in Africa, for example:
  - Shortage of teaching-laboratory equipment, import of which is restricted by foreign currency limitations.
  - Most consumer goods of technological nature are imported in finished form, and their repair and maintenance is scarce. As an example, lack of solar energy implementation can be attributed to this.
Non-IP Driven Entrepreneurship… (2)

- Possible alternate entrepreneurship route for scientists and engineers with opportunity for self employment, and to generate employment for others include:
  - Manufacture, assembly, innovation, and servicing of teaching laboratory equipment including glassware.
  - Assembly, repair and maintenance of technological consumer good, including solar energy systems.
  - Establish private testing, calibration and measurement laboratories to provide services to government departments, industry etc.
Non-IP Driven Entrepreneurship… (3)

- Franchising of ongoing technology based businesses from within or outside the country, or purchasing of rights to IP with market positional.
- Production and marketing of proven traditional medicinal and consumer goods for the modern consumer market.

Most of these ventures can be started with appropriate training, that shall include some technical aspects of the ventures, as well as some business skills. The following training components need to be considered:
Non-IP Driven Entrepreneurship… (4)

- Assuming that any start-up shall initially be a small venture with minimal hired workforce, an entrepreneur/partners shall need to understand most of the functions of the company.
- Proposed training course(s) contents may include any or all of the following:
  - Legal issues: Registering a company, company laws, labour laws, taxation laws.
  - Management issues: Business plans, staff welfare, strategic planning,
Non-IP Driven Entrepreneurship… (5)

- **Financial issues:** Dealing with banks, Government and other financial agencies, negotiating loans, grants, insurance, pension funds, business accounting procedures, understanding financial documents.

- **Safety and security issues:** The safety and security infrastructure, accident cover and liabilities.

- **Technical issues:** Understanding of, and hands-on practice on (some of) the equipment and machines to be used in the intended entrepreneurial undertaking.

- **IP Issues** could be covered at introductory level.
3.3. Scientific Collaboration and Networking

- Networking has become a prerequisite for excellence, relevance, and multidisciplinarity.
- Pooling skills and resources not just aggregates the skills and talents, but they are multiplied.
- Research and innovation of high level to meet the global challenges requires more than the resources of a single laboratory or even a single nation.
Collaboration and Networking (2)

- **The AMSEN Network**: *(Started 2008-2009)*
  - Universities of Botswana (Coordinator: Prof. P K Jain), Nairobi, Namibia, Wits, and FUTA, Nigeria.
  - Objective is to develop human resource in materials science and engineering by MPhil/ PhD training.
  - 20 students, fully supported by bursaries and research funding are currently registered in the program.
  - Each student is supervised by at least two supervisors including one from the home institution.
  - Facilities at every node are available to students from all other nodes. Travel between nodes is funded through AMSEN.
4. Conclusions

- Because of the lack of research infrastructure, at present and in the near future only non-IP driven science based entrepreneurship can be promoted successfully.
- IP-driven entrepreneurship can be implemented successfully only after the quality of science education is improved, and infrastructure for quality research and innovation has been created.
- By the time a vibrant research & innovation infrastructure is in place, the first generation of non-IP entrepreneurs will have matured to provide support to the IP sector.
5. Recommendations

- Following training programs are recommended for entrepreneurs, IP professionals, inventors and trainers.
  1) **Regional workshop** of one week duration for practicing researchers and inventors to train them on IP generation, protection and commercialization which can be organized in collaboration with IoP, and ICTP who have conducted them successfully over the past several years.
  2) Introduce **entrepreneurship course(s)** in science and engineering curriculum to produce new generation of entrepreneurs and inventors.
  3) **Short course of 4 to 8 week duration** for faculty to teach the entrepreneurship courses, and IP professionals at universities to advise researchers.
5. Cost Implications.

1) **Regional workshop**: For 40 - 50 delegates, cost is estimated at **US$50,000/=** to meet the local expenses. Delegates provide their own travel. IoP and ICTP could be approached to fund the travel for facilitators/experts.

2) **Entrepreneurship course(s)**: Salary and benefits for one staff to teach the course who could also be IP consultant for researchers: Estimated at **US$60,000/=pa**

3) **Short course of 4 to 8 weeks duration**: This will involve the salary, travel and hospitality for one expert to teach the course, and is estimated at **US$25,000/=**. If staff from other universities/institutions could attend, the cost could be shared.
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