POSSIBLE APPROACHES TO COMMERCIALISABLE UNIVERSITY RESEARCH IN KENYA

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Abstract
Serving society has become a coherent mission of universities besides the traditional missions of education and research. This involves linking teaching, research and commercialization of research to create an entrepreneurial university. The aim is to make universities major contributors to economic transformation and development of society via research-based entrepreneurship. Unfortunately, the idea of an entrepreneurial university is yet to take off in Kenya. This paper aims to propose some approaches which can be adapted to make university research in Kenya commercialisable. A systematic literature survey found that approaches to commercialisable university research lie between a wider view to university as a creator of intellectual and social capital for and in society and a narrower view to university as optimizing commercialisation of research as fund-raising function. This paper discusses four approaches: - National Project Approach (NPA); Community-University Cooperation Approach (CUCA); Industry-University Cooperation Approach (IUCA) and University Spin-Off Approach (USOA). NPA is based on University-Industry-Government (UIG) triple helix relationship with the government being the principle agent (PA) directing and facilitating university research and research-based entrepreneurship. IUCA is a double helix relationship with industry as the PA facilitating research geared towards innovation or invention in universities. In CUCA the university is the PA identifying community needs and facilitating science/technology based entrepreneurship to meet those needs. In USOA, universities support staff and graduates to engage in commercialisable high end advanced science/technology research to project an image and cut a niche for themselves. In conclusion, adapting any one of these approaches will ensure strategic, systematic and focused university research geared towards generating sustainable startups, ventures, patents or science/technology based MSMEs. This will make Kenyan universities get actively involved in the second academic revolution and positively contribute towards knowledge based economic development, vision 2030 and improved well-being of the people of Kenya.

Key words: Entrepreneurial university, research/technology based entrepreneurship

1 Introduction

1.1 Academic Entrepreneurship

A major aspiration of science is to advance the living standards of human beings and, if at all possible, secure a bright future for generations to come. This is an aim that requires development and commercialization of scientific discoveries (Peng, 2006). It is in line with this aspiration that universities, especially in the developed world, have come to be considered as a source of knowledge for creating knowledge based social-economies in the last decade. This has created new goals for universities: besides the traditional missions of education and research, serving society is becoming a coherent mission of universities. Transition towards fulfilling this third mission is called the second academic revolution (Etzkowitz, 2004). Active universities in the second academic revolution are called entrepreneurial universities. Such universities interlink three missions: education, research and serving society as illustrated in Figure 1.

Institutionally, the concept of an entrepreneurial university means having in a university structure, besides traditional education and research functions, a Technology Transfer Office (TTO) and active patenting of own research results by the university (Baldini, 2006). It also means creating entrepreneurial competencies and mindset among university members; active positioning to production and implementation of university knowledge for prosperity of society and an entrepreneurial environment inside and around the university. To integrate already well-known teaching and research functions to commercialization of research in an entrepreneurial context, the entrepreneurial university should adapt a business model that is functional enough for mapping patterns of main processes of university R&D commercialization and how university is creating value from its own research. For that purpose the concept of a business model (Figure 2), implemented before in companies' framework (Chesbrough and Rosenbloom, 2002) has been adapted for the entrepreneurial university (Mets, 2009).

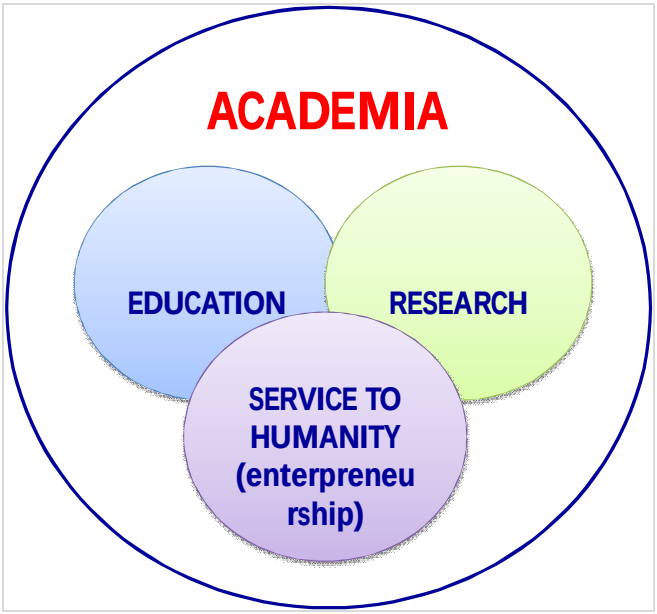

Figure 1: Model of Entrepreneurial University

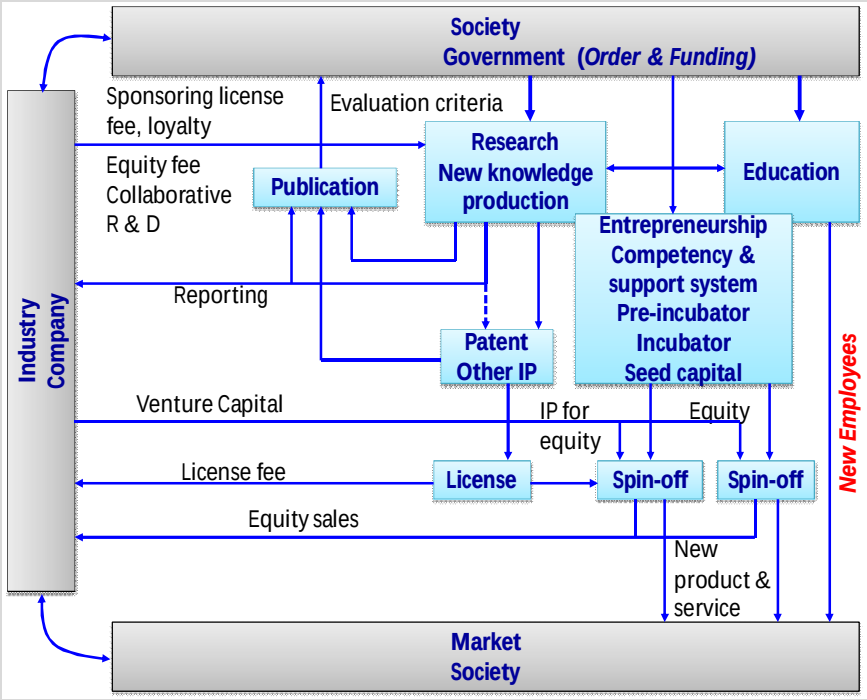

Figure 2: Business model of an entrepreneurial University

1.2 Entrepreneurial University in Kenya

At present universities, in the developed and underdeveloped world alike, face considerable pressures to expand their undertakings to play a broader role in the competitive knowledge-based economy. This is because the responsibility of the university in economic development has taken a central stage in many higher education policy circles. Knowledge is the key resource that forms the institutional basis of the post-industrial economy and society. It should be emphasized that it is institutions of higher education that give tangible expression to this argument by acting as catalysts for knowledge and research-driven economic growth as well as well-being enhancement. All this finds embodiment within a new techno-academic paradigm in which the academic knowledge base is centre stage as a determinant of industrial change, economic growth and general well-being. Therefore, higher education institutions should not be viewed as a regional or national resource, but rather as a node in an increasingly seamless knowledge base, which has progressively formed an interface with the knowledge-driven global economy (Kinsella and McBrierty, 1997). The aim is to make universities major contributors to economic transformation and development of society via research and technology based entrepreneurship.

Unfortunately, Kenyan universities have not caught up well with the rest of the world in this second academic revolution. They still continue to operate on a curriculum that is biased towards preparing graduates for white colour jobs i.e., graduates are trained to be job seekers and not job creators. A study done by Bosire and Etyang (2002) found that a majority of small-scale business owners in Kenya are secondary school graduates and lower. This is paradoxical in that employment opportunities for post-secondary school graduates remain low and for many of these, it is very difficult to find jobs - leading to a negative return on investment in Kenyan university education. To compound this, rapid expansion of university education through the self sponsored degree programs has tremendously increased the number of university graduates who are seeking for jobs which are simply not there.

Research and technology based entrepreneurship is a very effective tool for creating sustainable employment and income for these graduates. If utilized well, it can lead to poverty alleviation, improved well-being and in the long-run, the general development of the country. The U.S.A is a good example of how innovation/research based entrepreneurship can move a country to relative economic prosperity (Ngosiane, 2010). It is one of the most "entrepreneurial" nations in the globe because Americans believe that they have opportunities to be innovative and start businesses. Their education and culture respects entrepreneurship as an occupation and prepares grandaunts to be entrepreneurial as well as risk takers.

However, for any research to generate a start-up or venture that can grow into a sustainable Micro, Small or Medium Enterprises (MSMEs), it should be strategic, systematic and holistic enough to result in an innovation or invention. An innovation or invention here, may take the form of a new or better product or service. Kenya's vision 2030 emphasizes the need for appropriate entrepreneurship strategy for wealth creation as one of the means to make Kenya a globally competitive and prosperous nation. The National Science, Technology and Innovation (ST&I, 2008) Policy and Strategy has identified ST&I as a foundation for Vision 2030. This means that both vision 2030 and the ST&I policy recognize that the greatest impediment to entrepreneurship in Kenya is a lack of entrepreneurship culture (Ngosiane, 2010). To promote this culture, the government, the private sector and universities should work together to put in place measures that foster mobility between universities and the private sector in order to transfer knowledge and ideas, facilitate the entry of new participants with innovative ideas, and foster a culture that encourages risk-taking and accepts failure as permissible social and individual norms (Carter et al., 2003; Kolvereid and Isaksen, 2006; Kruger *et al*., 2000). The importance of universities in building a stronger culture of entrepreneurship in Kenya should be emphasized. A number of approaches (Kruger *et al*., 2002) can be used to make university research commercializable and thus make Kenyan universities become actively involved in the second academic revolution.

1.3 Motivation and Objective of Paper

Between April, 2009 and March, 2010 this author participated in an internship on research/technology based entrepreneurship in Japan. This program was run by an industry-university cooperation office in the graduate school of engineering in Osaka Prefecture University where the author did his graduate studies. The program entailed selection of final graduate research projects in which industry was interested and funding them for further investigation into possible commercial utilization of findings of such projects. Funding for the program was provided by the central government while mentorship was provided by an interested host company under an high tech incubation environment. This author's doctorate research project was among those selected at that time. This provided him with an opportunity for a one year internship in a bio-incubation centre. It is the experience gained during that internship period which motivated the author to undertake this study.

The objective of this paper is to propose some approaches which can be adapted to make university research in Kenya holistic and responsive to the employment and income needs of the people. The author opinions that if adapted, such approaches can ensure focused, systematic and holistic university research that will result in enterprising innovations and inventions leading to a vibrant entrepreneurial university culture in Kenya.

The paper is divided into four sections. Section one provides the introduction in which the idea of an entrepreneurial university and the objective of the paper are presented. Section two presents the methodology and findings of the study reported herein while section three discusses four different approaches which may be adapted for commercialisable university research in Kenya and thus make the local universities to get actively involved in the second academic revolution. Section four and five presents the conclusion and references, respectively.

2.0 Study Methodology and Findings

The study was conducted via systematic survey of literature. Three sources of literature were utilized- journal publications (hard copy and electronic); conference proceedings (hard copy and electronic) and the World Wide Web. At the start of the study, the author collected all literature (he could access) with information on commercial utilization of university research, academic entrepreneurship or research/innovation based entrepreneurship. For ease of investigation, these sources of information were categorized into three groups: those with information on entrepreneurial university and research commercialization in general; those with information on research and commercial utilization of research in Kenya and those with approaches used to facilitate and commercially utilize university research and innovation. This categorization was not in any way unique but convenient. After a comprehensive and focused investigation, the following summarizes the findings made from these various forms of literature:

The concept of an entrepreneurial university entails active utilization of university research for commercial purposes. According to Howard (2005) and Mets (2009) knowledge transfer and entrepreneurship domain in an entrepreneurial university business model have the following roles:

- Knowledge diffusion: This is covered mainly by scientific and popular publications as well as standards; capacity building of university graduates – new employees for private and public sector carrying new knowledge to their jobs; life-long (post-graduate) training, but partly also via other staff, public and personal communications; and (not protected as IP) new products and services launched by university spin-offs. Knowledge diffusion also means creation of social capital and sharing of knowledge via networks. Here, the role of entrepreneurship domain is mainly educational: training university students and facilitating entrepreneurial culture within the region.

- Knowledge production: This means patenting new technology at first, and following with publications, sales of licenses on patents and other protected IP to industrial partners. Partly, this function is covered with investment of own IP into spin-off companies and financial involvement of venture capital. Here the role of entrepreneurship domain (support system) is mainly targeted to spin-off processes and entrepreneurial attitude and competencies of the academic personnel, including development of entrepreneurial environment, business incubation, consultancy and mentoring, seed and venture capital funding, etc.

- Knowledge relationship: This includes donation and corporate sponsoring of research projects and funding of chairs or scholarship, contracted teaching services, research and consultancy, cooperative and collaborative research, business and research partnerships, including industry (trans-disciplinary) research centres and institutes, joint laboratories, facilities and ventures. Because of complexity of ownership, IP becomes special issue in this relationship. The roles of entrepreneurship, in addition to those listed above, are strategic and management support functions on industry (trans-disciplinary) level, including linking business and IP strategies.

- Knowledge engagement: This comes from the third mission of university and means interaction between universities, industry (business) and government to solve complex problems in society. The need for that comes from non-linearity of innovation processes which need active collaboration of UIG partners in the field of strategic issues of knowledge-based economic development including R&D and knowledge transfer policies and support measures on the state level. The complex domain of entrepreneurship can be implemented as facilitator of entrepreneurial competence and culture via education and creation of entrepreneurial environment transcending university boundaries.

The concept of an entrepreneurial university has not gained much footing Kenya though some local universities have started integrating entrepreneurship into their traditional functions. However, this is mainly based on other forms of businesses and not commercial utilization on their scientific and technological breakthroughs.

Approaches to knowledge production and commercialization related processes are fulfilled in different frameworks of University-Industry-Government (UIG) linkages as examined by a number of researchers, for example, in regional development (Etzkowitz and Klofsten, 2005), learning (Matley and Mitra, 2002), knowledge networks (Carayannis and Alexander, 1999) and intellectual property (IP) system (Kelli and Pisuke, 2008) context. However, these approaches fall into two major categories: one, those which hold a wider view to university as a creator of intellectual and social capital for and in society and two, those with a narrower view to university optimizing commercialization of research as a fund-raising function. Other approaches could be located somewhere between these two.

Of particular interest in relation to main aim of this paper is the third finding. Based on this and tapping to the experience gained during a research/technology based entrepreneurship internship under an industry-university cooperation frame work, the author suggests four approaches that can be adapted to make university research in Kenya commercializable. These are: Nation Project Approach (NPA), Industry-University Cooperation Approach (IUCA), Community-University Cooperation Approach (CUCA) and University Spin-off Approach (USOA). The first three belong to the wider view to university as a creator of intellectual and social capital for and in society while the last one belongs to the narrower view to university optimizing commercialization of research as a fund-raising function. It is this author's point of view that adapting any of these approaches will promote commercial utilization university research in Kenya and hence cause the local academia get actively involved in the second academic revolution. These four approaches are discussed in detail in the next section.

3 Approaches to Commercializable University Research

3.1 National Project Approach (NPA)

This approach is premised on a triple helix Government-Industry-University (GIU) relationship (Mets, 2009) schematically illustrated in Figure 3. Here the government is the principal-agent (PA) in generating programs to promote academic entrepreneurship. In this approach, the government based on recommendations of a national think tank, can come up with a theme to advance its science, technological and industrial agenda or to solve some complex problem in society. It can then facilitate the realization of this agenda by: identifying and bringing together universities, research organizations and industries capable of carrying out the agenda; funding research and development activities to realize the agenda; establishing neutral regional incubation centres and centres of excellence where universities, industry as well as research organizations can meet freely to carry out their mandate in relation to the agenda; monitoring the progress as well as time lines; and providing any logistical and infrastructural requirement related to the agenda.

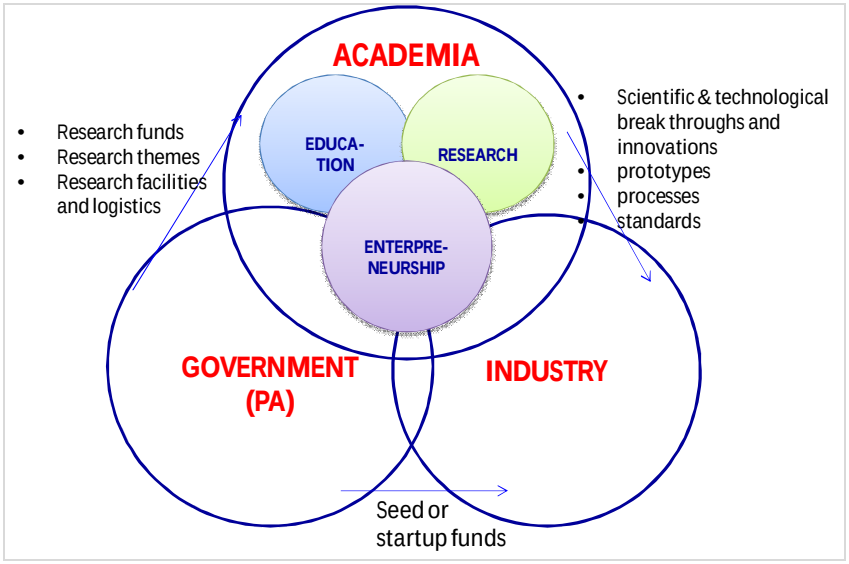

Figure 3: Model of Government-Industry-University relationship

For instance, the government think thank may recommend that the government needs to develop an edible vaccine for malaria. Edible vaccines are those which can be administered by eating (Mishra *et al,* 2008). They hold great promise as a cost-effective, easy-to-administer, easy-to-store and socio-culturally readily acceptable vaccine delivery system, especially for the poor developing countries (Shah, 2011). Production of edible vaccines involves introduction of selected desired genes into plants and then inducing these altered plants to manufacture the encoded proteins (Shah, 2011). Figure 4 illustrates a number of tasks requiring a holistic research that is needed to develop an edible vaccine. The tasks can be divided into four main processes: development, production, safety and control and distribution. Vaccine development entails selection of vaccine target (antigen) and identification of its coding sequence; transfer of the coding sequence to a gene vector; incubation of gene vector with plant tissue culture; generation of whole plants from transformed cells and characterizing antigen expression; and defining antigen immunogenicity via animal model studies. Vaccine production involves development of biofactory as well as tissue culture and mass production systems. Development of vaccine control and safety as well as distribution systems concludes the processes.

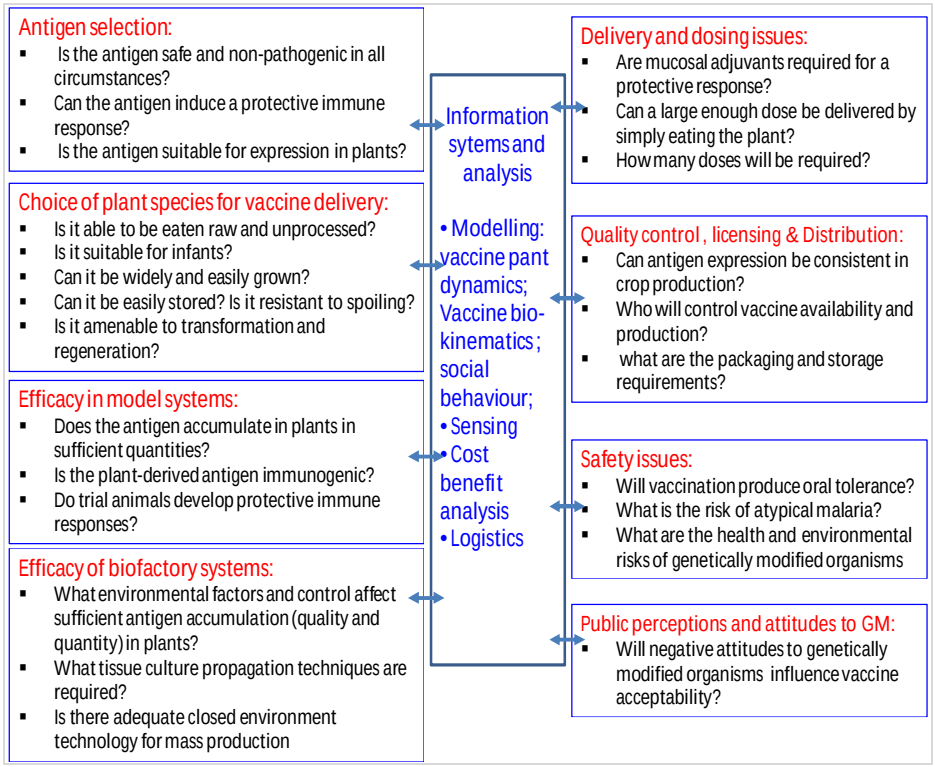

Figure 4: Tasks required for holistic research toward development of an edible vaccine

To achieve this government will first need to set aside adequate funds needed for research, development, trials and commercial mass production of the vaccine. It will then need to bring to one table a number of players as KEMRI (Kenya Medical Research Institute), Universities and university hospitals, KARI (Kenya Agricultural Research Institute), biotechnological and biopharmaceutical companies and community leaders. The players will identify all activities required to realize an edible malaria vaccine. Based on level of competency, each player will be allocated specific tasks. Under the guidance of the government, the players will establish a time frame, road map and bench marks needed to accomplish their tasks. The players will also identify the facilities needed to carry out their mandate. The government will need to establish research, innovation and incubation centres which are neutral enough to attract competing players to comfortably participate in the project without the issue of equity and regional balancing cropping up. It will then provide each player with the funding and logistics required to complete its activities. It will also need to monitor the progress of the project through timely periodical reports and workshops during which each player will present its progress and be accessed against specific benchmarks and road map.

As an approach to commercial utilization of university research, NPA provides a forum for building strong GIU relationships for tackling national issues like unemployment, health and environment both at the county and national level. This approach also presents a convenient way for the national and county governments to advance their science, innovation and technological agendas. In addition, it can help universities get adequate facilitation to carry out their research mandate while fully participating in the development of the country. However, the approach may lead to: government patronage over universities - both at the national and county levels; alienation of universities and industries not participating in the national project; and rivalry among universities as they try to catch the government's eye so to say.

3.2 Industry-University Cooperation Approach (IUCA)

This approach is premised on a double helix relationship involving industry and university (IU) as illustrated in Figure 5. In this approach the PA is the industry. Here, the industry enters into cooperation or collaboration with some selected universities depending on their area of excellence. It then sets up research or industrial parks in those universities. These research or industrial parks are equipped and run by industry which engages the academia to participate in research themes relevant to its interests within given frameworks. The academia here includes staff and graduate students (sponsored by the industry). Sometimes the industry may set up an advanced research and technology centre within the university or within itself where the university can develop innovations and inventions which are purchased by the industry. In either case, the industry must set up incubation centres where the academia can try to convert their research into start-ups which may be bought by industry or become industry spin-offs.

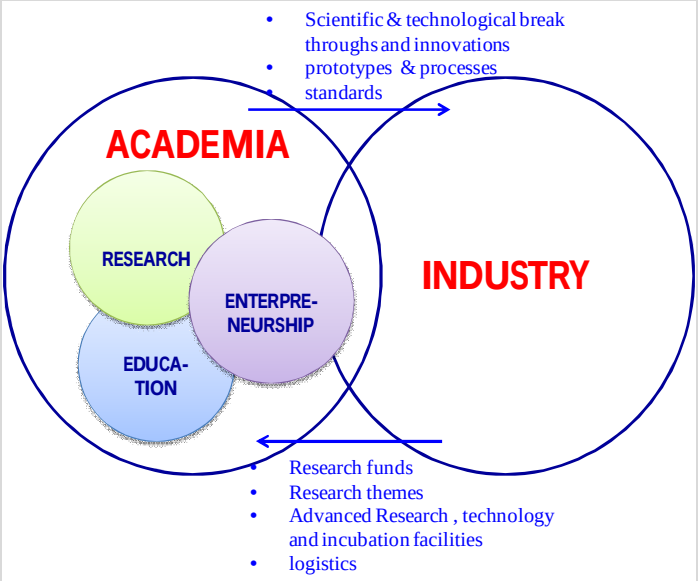

Figure 5: Model of Industry-University relationship

As an example, a company in the energy sector may want to develop bioethanol as a clean and sustainable biofuel to cut a niche for itself. Figure 6 illustrates the main tasks for a holistic research intervention required to develop a successful and sustainable power ethanol industry. These tasks can be grouped into: those concerned with the production of biomass feed stock for bioethanol (green rectangles) and those related fuel bioethanol production (red rectangles). Research on pre-harvest crop monitoring will be needed to develop optimized instrumentation and data processing systems for monitoring crop growth, health as well as stress and to develop algorithms for precision and site specific operations. To develop cost-effective processes and optimize equipment for harvesting and collecting biomass will require research on harvesting of energy crops. Research on transportation of biomass will be required to provide practical solutions to conveying biomass feedstock from the field to storage location of bio-refineries in sufficient quantities and optimum rates to sustain profitable biomass-to-energy conversion. Development of guidelines for locating and sizing storage facilities as well as storage and preservation methods that will ensure adequate supply of high quality biomass to processing plants will require research on storage of biomass. Research on processing of energy crops will be required to develop optimum processes for bioethanol production while research on bioethanol utilization will help develop standards for its efficient use. To develop

guidelines for safe handling and transportation, sizing and locating of storage facilities as well delivery systems to ensure customer satisfaction, research on bioethanol storage and distribution will be required. Systems informatics and analysis will be required to integrate information and knowledge from various sources related to biomass feed stock and bioethanol production. Thus, the company will need to identify universities with competencies in these different areas of research intervention highlighted. It will then provide infrastructure, logistics, coordination and funding needed to undertake the activities after signing a comprehensive MOU with those institutions.

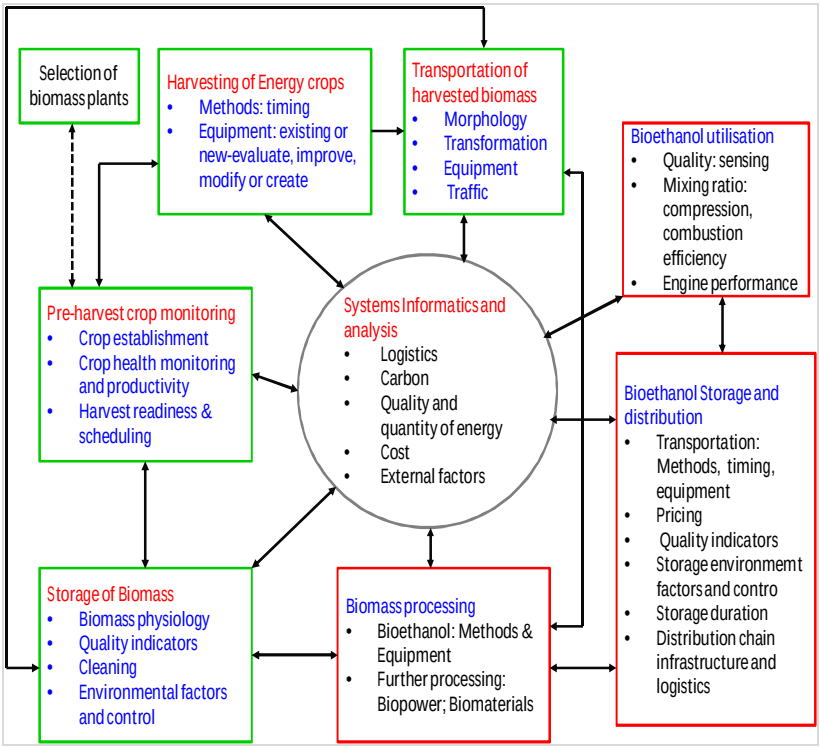

Figure 6: Tasks required for holistic research for a feasible bioethanol industry

This approach presents a number of merits including: one, it enables universities to access state of the art facilities for research and innovation; two, it avails adequate funds for university research; three, it provides opportunities for employment for staff and graduates; and four, it provides an avenue for academia to influence industry, job creation and development. On the other hand, IUCA may lead to: patronage of industry over university; rivalry among university academic staff – not all can be engaged by the industry; suppression of free thinking as researchers may be tempted to orient their research activities to themes attractive to industry; and exploitation of academia by industry - the researchers are compensated only for their research activities regardless of the volume of revenues resulting from it. In addition, they may have no property rights for any discovery or invention that may arise as it will be deemed the property of the facilitating industry. A comprehensive memorandum of understanding can resolve this.

3.3 Community-University Cooperation Approach (CUCA)

A double helix Community-University (CU) relationship (Figure 7) forms the basis for this approach. Community here mostly refers to the immediate community where the university is located. Here, the university through outreach, extension, open campus or any other form of interaction with the community, identifies a need in the community. It then engages its staff to come up with scientific/technology based ways of meeting that need. The university can then raise funds (from the government, NGOs or other sources), conduct research and implement the solution. The university

will also need set up a community innovation, talent development and incubation centre where interested community members are invited and supervised to try the innovation (generated by the university or their own) and talents. On maturity, the ventures move out of the incubation canter but the university can continue couching or evaluating their performance while receiving a portion of the revenue generated so as to enable it recoup any funds directly invested in the venture.

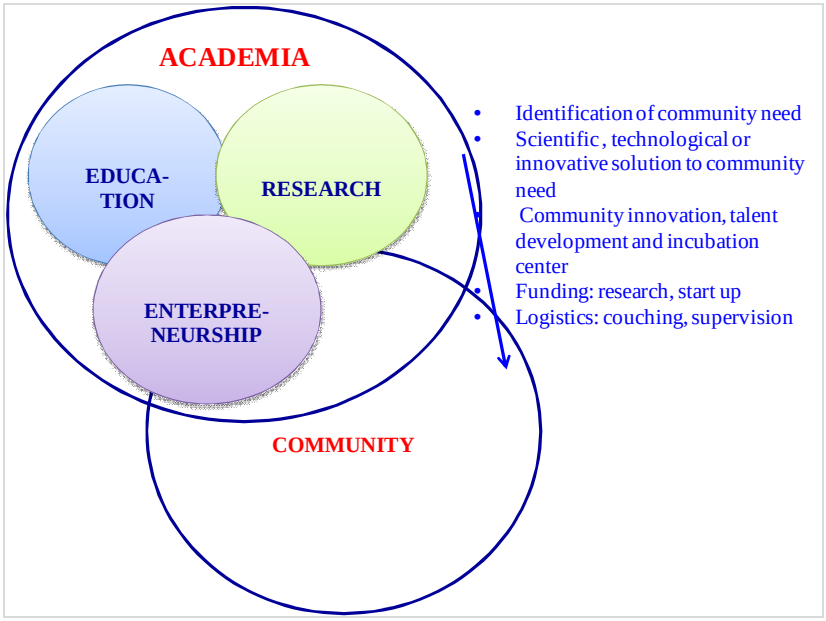

Figure 7: Schematic model of CU relationship

For instance, a given university may identify commercial vegetable production as a viable intervention for alleviation of unemployment and poverty in its immediate community. However, a successful and sustainable vegetable production business will require an innovative approach involving a number of research intervention tasks as summarised in Figure 8. Research on pre-harvest crop monitoring will be needed to develop optimized instrumentation and data processing systems for monitoring crop growth, health as well as stress and to develop algorithms for precision and site specific operations. Harvesting of vegetable crops research will be required to develop cost-effective processes and optimise equipment for harvesting and collecting vegetables. To provide practical solutions to conveying vegetable products in sufficient quantities and the optimum rates to sustain profitable production-to-consumption distribution while maintaining quality and customer satisfaction, research on transportation and distribution of vegetables will be required. Research on storage of vegetables will be necessarily to develop guidelines for locating and sizing storage facilities, as well as storage and preservation methods that will provide adequate supply of high quality vegetables to customers. To provide alternative utilization of vegetables so as to ensure minimum wastage and adequate market during overproduction, research on further processing of vegetable crops will be necessarily.

Figure 8: Tasks required for holistic research leading commercial vegetable production

The CUCA presents a number of merits: one, it can enable the university give something back to the community (good cooperate responsibility); two, it can enable the university participate directly in improving the well-being of its immediate community. Three, it can enable universities fulfil their outreach commitment to the county and national government funding agencies. However, this approach may strain university resources if funding is not readily available; requires active outreach by the university and maximum cooperation from the community.

3.4 University Spin-Off Approach (USOA)

Shane (2004, p 4) defines a university spin-off as ‘‘a new company founded to exploit a piece of Intellectual Property (IP) created in an academic institution’’. Thus, one way of utilizing academic research in a commercial manner is to set up the so-called university spin-off companies (Meyer, 2003). This approach is based on the trans-disciplinary entrepreneurial university model (Figure 9). Including an entrepreneurship function into the university means also implementation of more active measures for technology transfer (TT) as well as knowledge transfer (KT). In addition to TT and KT offices (Baldini, 2006), universities are also required to establish university advanced science, technology and incubation centres as well as a directory of venture capital companies both locally and internationally to enable them establish successful and sustainable spin-off companies. The entrepreneurship domain in the university KT plays a number of roles (Baldin, 2006):

(i) supporting university spin-off processes,
(ii) linking different disciplines into integral part of knowledge and technology transfer,
(iii) shaping entrepreneurial attitudes among university personnel,
(iv) creating entrepreneurial attitudes among students via education.

The first role has direct impact on TT and KT via spin-off companies. The second role creates better understanding and higher trans-disciplinary competencies among academicians in different technological, legal, economic and social aspects of R&D and knowledge production for

commercialization. The third role has indirect impact influencing on orientation and selection by researchers thematic fields and goals for R&D and implementation of new ideas in real business or other fields of society in the future. The fourth role prepares the new generation of researchers as well as business and technology players for a given region – that means long-term impact on the entrepreneurship environment of the region and readiness for collaboration from all sides: academia (university), companies (industry) and region (government). In that way Academic Entrepreneurship (AE) training and education becomes a part of the entrepreneurial university model with long-term orientation.

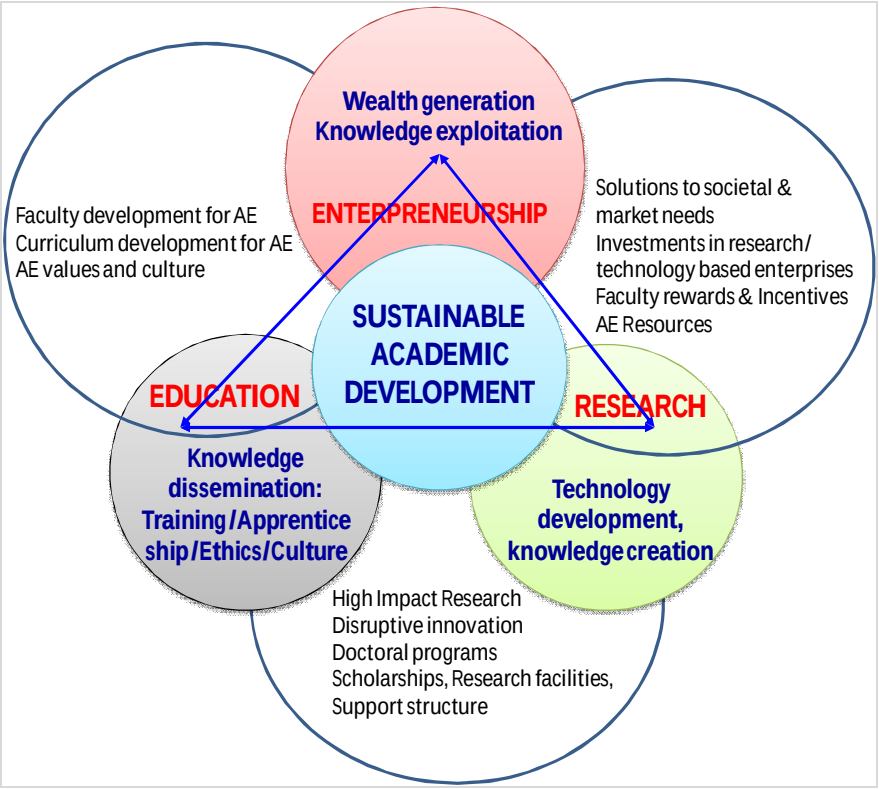

Figure 9: Schematic model of trans-disciplinary entrepreneurial university

This approach is particularly suited for commercial utilization of high impact scientific and technological breakthroughs which otherwise industry is not willing to readily invest in. For instance a university may want to cut a niche in a high-tech field like nanobiotechnology. Figure 10 illustrates a number of research areas that can result in commercializable high impact breakthroughs in nanobiotechnology and bionanotechnology (Freitas, 2005). Take for instance nanobiorobots roaming in the blood with reprogrammable DNA/RNA capability. When they meet a target cell say a cancerous cell or HIV infected cell they reprogram it destroy itself. It is unimaginable how revolutionary that will be in medicine. Yet industry may be risk averse to invest in such untested technology. Thus, the university concerned will need to spin-off a high-tech company to pursue commercial utilization of such breakthroughs. To achieve this, the university will need to provide a supporting environment for knowledge transfer to ensure that a productive and profitable spin-off company is established. A conducive environment here will entail establishment a high tech incubation centre, provision of venture capital, in addition to training of the university community on AE. The university will maintain a stake in the holdings of such a company and an established spin-off company will carry the institution's brand with it.

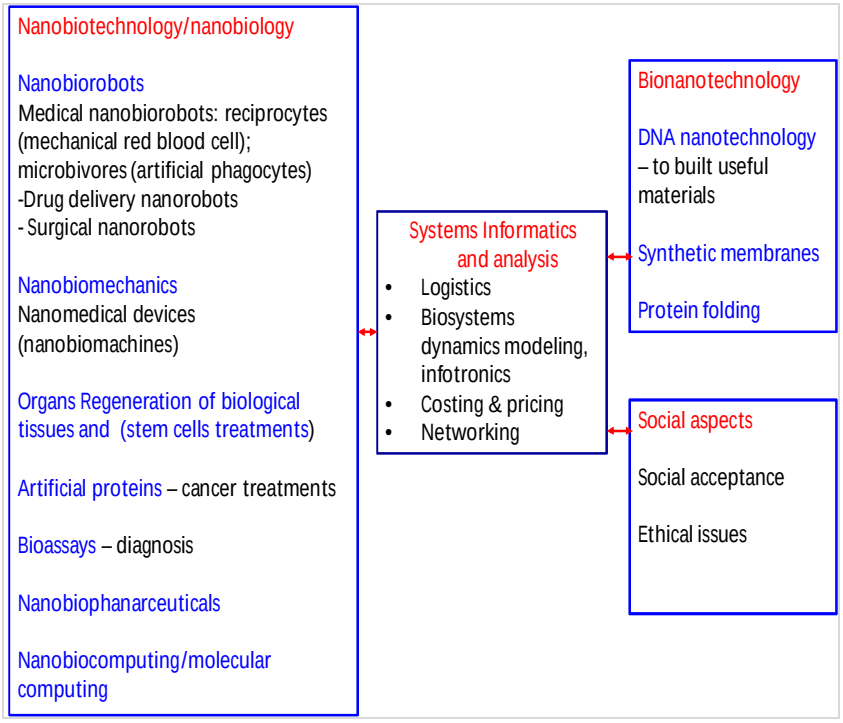

Figure 10: Areas of commercializable high-impact breakthroughs in nanobiotechnology and bionanotechnology

A major advantage of the USOA is that it provides an avenue for commercial utilization academic research that it is free of the constraints experienced in the other three approaches so far discussed. Thus, it encourages universities to pursue their research interests freely and with lots of flexibility. Another advantage is that it makes it possible for novel scientific breakthroughs and innovations, in which industry has no immediate interest, to develop into useful products of services for the benefit of society. Hence, it is most suitable for high end science and technology research that can enable universities project an image and cut a niche for themselves. In addition, this approach provides a dynamic and diverse research environment for faculty and students, additional training opportunities for students, funding from industry, and employment opportunities for its graduates. However, the pressure for commercialization of scientific research breakthrough output can have negative impact on the maintenance of appropriate ethics of research conduct in the universities. For example some corrupt researchers may forge data just so as to make that *'product-X efficiency plot'* look statistically significant for an investors meeting. Fortunately, such issues can be avoided by establishing AE laws or emphasizing research ethics guidelines and even by the provision of necessary incentives to researchers in universities.

4 Discussion and Conclusion

The role of entrepreneurship domain in and around university: from knowledge production to knowledge and technology transfer and implementation by industry; from mono-disciplinary university model to trans-disciplinary entrepreneurial university; from entrepreneurship education targeted to university members for facilitating enterprise to creating entrepreneurial attitudes in society generally (ECSB, 2009) can be achieved via a number of approaches. These approaches can be classified into: those which hold a wider view to university as a creator of intellectual and social capital for and in society; and those which hold a narrower view to university optimizing commercialization of research as a fund-raising function. Other approaches can be located somewhere in between. Which approach to prefer depends on the agreement between society and

the university; level of development of a country and national goals; strength of University-Industry-Government relationships and the university's long term goals.

In Europe, Asia and North America, universities take pride in listing the number of spin-off companies established, number of patents received and number of collaboration MOUs and research funding signed annually. Universities in these areas have realized that serving society is an integral mission of their functions and are in the true context, entrepreneurial universities. To what extent the same can said of Kenyan universities known. However, it is the view of this author that the approaches discussed in this paper can help improve the performance of local universities in conducting holistic research that can be utilized commercially.

The national project approach presents the most convenient way for the national or county governments to advance their innovation and technological agenda. It provides an avenue for the Kenya government to compete or stay ahead in research, innovation and technology. It also presents a way for the county governments to cut a niche for themselves among their peers. The Industry-University Cooperation approach provides an avenue for Kenyan firms to benefit from research capabilities of the university. On the other hand it will enable universities in Kenya access the much needed research funding. The CUCA provides an avenue for the local universities have positive impact on the well-being of the local communities. The University Spin-off approach presents a suitable way promoting high end science and technology research in Kenyan universities. This approach requires establishment of university technology incubators not located in traditional high-tech areas, and could therefore help to equalize the development level in different regions in an industrialized country. For developing countries, such as Kenya high-tech centres are rare. Therefore, iIt may be a reasonable strategy for these countries to build up their high-tech innovation basis through university spin-off companies and technology incubators (Peng, 2006).

In conclusion, any of the approaches discussed in this paper can be adapted on its own all in combination with others. Whether to adapt a given approach will depend on societal needs and the universities goals and commitment. However, non active participation in the second academic revolution is not an option for Kenyan universities. In fact, it is the view of this author that that given the unemployment and poverty levels in the country, Kenya needs the entrepreneurial universities even more than the developed world. And applying these approaches can lead to focused and systematic university research geared towards generating businesses, startups, patents or venture companies that will positively affect income levels in the country. Even better still, is that the beneficiaries of such increased income will be local communities and the general population; Universities, entrepreneurs, investors and industries (via increased business opportunities and patents) as well as county and national governments (via increased tax revenue). In the long run, improved employment and income will reduce poverty and increase the quality of life of the people of Kenya. This will be a very a positive contribution to vision 2030 and millennium development goals initiatives. In addition to increasing research and technology based entrepreneurship, adapting these approaches will also help in forging closer working relationships among Universities, local communities, county and national governments and Industry in Kenya. The spillover effect is that such a closer relationship will lead to even more coordinated, systematic and holistic university research which will give rise to even more high-tech breakthrough innovations and inventions. This will definitely boost the image of Kenya in the world.

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