Models and suggestions for structuring innovation-centric universities to initiate knowledge based economies in the region

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***Abstract* — Nowadays innovation capability of a country is considered as one of the most valuable assets that contribute to the economy. One of the factor which shape the innovation capability of a country is the universities in that country. Together with the government policies and funding, universities can become initiators of innovation cycle which may lead to knowledge based economy transition in the country. In this paper models are given and suggestions are made for regional universities to assume this important new role.**

***Index Terms* — Technological innovation, Knowledge acquisition, Intellectual property, Education, Innovation cycle**

I. Introduction

Majority of the economists agree that with the globalization and information technology revolution the rules of the game for economic growth have changed. The resources like knowledge, know-how are becoming the coal, oil and diamonds of the 21st century for developed, developing and emerging economies [1]-[2]. In this century, innovation capability and innovations are considered most valuable assets that a country can have. By reading the changes taking place properly, developing proper policies and institutions in time, the regional countries can benefit from this change to knowledge based economy.

It is observed that countries like Korea who set up National Innovation System of developing new products and technologies have increased their GDP and propelled themselves into category of technologically developed countries [3].

The report published by OECD in 2001 titled "Innovative Clusters: Drivers of National Innovation Systems" state that [4];

> *"The challenge and the opportunity in particular for advanced developing and transitioning economies is to evolve and possibly leap frog from lower to middle income, knowledge-, technology-, and know-how importing and using countries to high and sustainable income, knowledge-, technology- and know-how generating and exporting ones. For such a transition to be effective and sustainable, key success factors are innovation and knowledge clusters and networks linking public and private, domestic, regional, and global sector research and technological development entities."*

Transition to such knowledge economy requires a suitable information technology infrastructure, appropriate rules and laws and suitable business climate for setting up high technology start-ups and businesses. Government policies surely play a very important role in setting up such suitable infrastructure but by no means government is the only player in this transition.

Universities, where the education of young minds take place and attitudes coming generations are shaped is probably one of the most player of this change [5]. Traditional role of the university needs to be broadened to accommodate these new goals.

There are examples of universities becoming initiators of this positive change in the world. By looking at these examples and relying on authors past experiences we will be making suggestions for our regional institutions for initiating this new role. It is our hope that by this change we not only leap frog toward knowledge economy in our region but also increase the enthusiasm of our students toward their subjects of study [6].

II. New role of the university

Innovation networks is defined as "… real and virtual infra-structures and infra-technologies that serve to nurture creativity, trigger invention and catalyze innovation in a public and/or private domain context (for instance, Government-University-Industry Public-Private Research and Technology Development Co-operative partnerships."[7].

University, being the traditional location for research and development is the appropriate location for nurturing and developing new ideas. Assuming this new role, though, requires appropriate attitude change from the university. With the knowledge revolution that is taking place, the idea of "research for the sake of research" is considered "out". Now research toward a specific goal, a goal which can be commercialized, is valued and desired. This changing attitude toward funded research is all too clear in the print of EU

Framework Program 7 which opened in the beginning of 2007. Now framework programs channel funds toward specific areas which are considered to have high potential for commercialization in the future.

The idea of commercialized research surely will scare some of the academicians, but this shift in focus toward research should not be considered as a total change of traditional attitude by universities. Universities should continue to emphasize educational priorities for undergraduate studies but should accommodate directed research as well as independent research in graduate studies.

Another very important duty that falls over the shoulders of the universities is about changing the attitudes of students and faculty toward new goals of the country. It is important to recognize at this stage that, merging from traditional to knowledge based economy is a goal set by the country and university is a part of that vision to make the change instrumental. Knowledge based economy will come as a result of many entrepreneurs' innovative ideas taking place through commercial companies serving the global economy. The change of attitude of public and especially the young generation from "consumer attitude" to "entrepreneurial attitude" is probably the most vital step toward achieving the goal of knowledge based economy. Since this is an attitude change needs to be ignited in early phases of the lives of the individuals, during undergraduate studies universities should find ways of implementing this attitude change.

If the undergraduate studies is the time to kindle this change of attitude, graduate studies should be the time to implement and bring into life the mechanism of reaping fruits of knowledge. The possible mechanisms to be used at this stage are;

- generating intellectual property patent,
- licensing patents,
- and generating university spin-offs.

University should play a role of a broker between students, faculty and government and industry to fulfill this role of generating commercial spin-off companies.

Although cooperation between university and industrial companies are very much desired for joint spin-off companies, studies indicate that so far this has not been working as desired due to unrealistic expectations from both sides [8]. Later in the paper there will be suggestions for a working relationship between companies and universities.

III. What is the source of innovation

Being accepted as a fuel of economy in the 21st century, what fuels innovation and how innovation cycle works is studied by many researchers. Knowing how this cycle works is absolutely essential if we want to make universities more functional in this respect. A recent study conducted among highly innovative firms indicated that, idea for innovation comes from different sources[9]. The following is the list of sources where innovative companies find their innovative ideas:

- customers,
- competitors,
- suppliers of software and equipment,
- suppliers of components and raw material,
- internal R&D department,
- universities,
- public research organizations,
- consulting market research firms,
- patent publications,
- technical journals and conferences,
- fairs and exhibitions,

The list is not ranked. Some of the sources in the list are considered more valuable by some firms than others.

A very significant find in the study is the fact that highly innovative firms consider their customers as one of the most valuable source for innovative ideas. This is a very significant finding which should be read carefully. Customers as the source of innovative ideas mean that customers relay their problems and the difficulties they are having with current solutions. By solving these problems, under contract or not, innovative firms come up with innovative solutions which they can commercialize.

Universities should read this finding carefully and do exactly what innovative companies do with their customers. Universities should consider industrial companies as their customers and reach out and get familiar with their problems without asking any financial compensation. The policy makers should adapt ways of forming this bridge between industrial companies and universities which would let university get exposed to problems in the industry.

One of the excellent ways of forming this bridge is adapting cooperative education program where the student spends several semesters in an industrial company and gets credited for his/her work. By modifying and enlarging the scope of co-op training, universities can have an insider view of the problems faced by industry. Every problem faced by industry can be a source of innovation if the problem is solved. We will be describing how such a university can function in section VI of this study.

IV. Ins and outs of innovation based university

Universities need to be at the forefront of the change if we were to adapt knowledge based economy. But this change will bring about some issues to the academia some of which may be considered beneficial but some of which may also be considered controversial. So here

are some of the issues and concepts that need to be tackled in case we set up an innovative centered university with commercialized research goals..

Entrepreneurial university: With this change of function to accommodate commercialized research, university becomes a major source of entrepreneurs. The climate of the university is totally geared toward generating entrepreneurs. Entrepreneurship courses are given to students, innovative projects are encouraged, and prospective project are evaluated and helped by university staff.

Academic freedom: Academic freedom is likely to suffer since priority in research funding is given to directed subjects which are determined by appropriate government institutions.

Commercialized research: Commercialized research concept is in. This means that research which will bring about revenue to university and staff is encouraged and prioritized.

Motivating staff and faculty: Innovation centric university regards staff and faculty as the most valuable resource in bringing about the change. The university becomes a more exciting environment with possibility of getting new career opportunities, even setting up spin-off firms by faculty and staff. Retention of productive faculty becomes a priority for the university. Universities get into a competition of having and if necessary, transferring innovative staff. Reputations develop, students desire environments which are more conducive for entrepreneurial development.

Highly regarded faculty: Faculty is viewed not only on educational capacity but also on how many spin-off companies and innovative projects he helped/generated. Successful faculty is highly regarded by the university, students and industrial companies.

Process of innovation is person dependant: Process of innovation is not a standard process but it is a person dependent process. Academic environment is likely to be shaped to accommodate best for the innovation process.

Added courses to the curriculum: With a shift of focus toward entrepreneurial university, there will be added courses on entrepreneurship, intellectual property etc. These courses should be accommodated alongside the existing curriculum.

Incubator university: The university now has the added responsibility to nurture and foster the prospective projects developed by staff and the students. University does this by providing an incubator environment rather than simply venture capital or seed funds.

IP issues: With the shift toward this new duty, university has to educate staff and students about IP related issues and should have an office to handle IP related business. Ownership of IP rights should be clear by all parties without the slightest doubt in mind. IP rules should be appealing to staff and students to have the cycle of innovation attractive and profitable.

Financial gains: There will be financial gains from this venture and how this gain is distributed among the players in the innovation cycle should be clear to all participants. Financial gains by students and the staff who are in the innovation cycle should be substantial enough to have the cycle alive, desirable and running.

Champion of the cause: There needs to be a champion of the effort while university is transitioning from traditional institution to innovation based university. The effort should be coordinated by a vice-rector or a dean level administrator.

V. SUCCESSFUL EXAMPLES FROM THE WORLD

Successful entrepreneurial universities exist currently and some of these examples are studied by researchers in detail [6].

Chalmers University of Technology is located in Gothenburg city of Sweden where there is a substantial industrial base. The university has 8000 students and 2500 staff members. Chalmers has a science park located in close proximity to the university campus which employs 4000 people. Chalmers student and faculty have resulted in formation of several hundred spin-off companies and average of 15 knowledge based spin-off companies are formed every year.

Another successful example is Norwegian University of Science and Technology which is located in Trondheim city of Norway. NTNU has 19,000 students and 3000 staff members. R&D activities in NTNU have resulted in formation of 120 spin-off companies over the span of 20 years.

Another example is the University of Oulu from Finland. University of Oulu has 13,000 students and 3200 staff members. University has a technology park in close proximity to the campus where 150 companies are employing 3500 employees. University generates 10-20 spin-off companies every year.

Yet another example is Trinity College Dublin of Ireland. Trinity College has 12,000 students and 1200 staff members. Trinity College has initiated 43 spin-off companies so far and generates 3 spin-of companies on the average.

VI. Model of an Innovation Centric University

Studying the successful examples and considering regional dynamics we suggest the following model for a innovation centered university. The suggested model will be narrated by using a fictitious institution appropriately named, Innovation Centered University, (ICU). Throughout the following discussion we will be using this institution which will be called ICU.

ICU is a small university with 5000 students and 850 staff with a student faculty ratio of 6:1. ICU adapts co-op education system, where students spend one semester in Junior, and one semester in Senior level working in an industry related to their subject. ICU officials have visited local industries and explained their vision of innovation centric university and signed up many companies. Companies signed up with ICU willingly, because this transaction does not cost the companies any money. The companies understand that student and at least one faculty from ICU, whose specialty coincides with that of the company, will be with them throughout the time student is with them. Company treats the students like regular workers with same working conditions. Student worker rotates through different departments of the company, to give a sense of how the whole process runs giving emphasis to students' specialty. Company is especially eager to make student spend time with departments where there is room for innovation. Student regularly meets its assigned professor in the workplace. Professor(s) visit the student every two weeks in the workplace and follow up with the development. Although this is way too much work for the professors, they have only two students to follow up and usually the professor schedules both visits in the same day which is his "out of office" day. Professor is enthusiastic about his field visits to students, since if there will be an innovation as a result of this activity, he will be rewarded both financially and academically. According to the promotion rules of ICU, such activities are considered acceptable merits toward promotion for professors. Company officials are also enthusiastic about the regular visits of the professor since they can expose problems that they face in the workplace even if the problem is not specific to the specialty of the professor. They know that if the problem is in the domain of the professor he will provide advise about it, if the problem is not in his specialty, most probably the professor would know somebody in ICU who may provide help for the problem. Company does expose the problems willingly, since this service do not cost them anything, and if there will be an improvement as a result of this activity, it will be good publicity for the company. The company knows that their trade secrets are protected by a confidentiality agreement signed between ICU staff and the company. If there will be a financial gain through a possible innovation, they will all be gaining from this transaction. All players in the co-op process actively participate in this innovative cycle. A special co-op office at ICU follows up with the co-op process and companies or staffs who are not participating positively to the process are removed from the circulation. This co-op office is under the control of a vice –rector who is responsible for innovation centric activities of the ICU.

ICU administration observed that co-op students are enthusiastic learners. Students see the needs in the real world and concentrate on their studies accordingly. Through their co-op education they learn both know-why and know-how process related to their field of study. They understand that knowing why we do things is the first step in innovation. Studying in an innovation centric university, they know that if they come up with an innovative idea they can have the support of ICU to start up a company of their own which is a dream for many seniors in ICU. With this psychology, when it is time to do their senior project, they take up a project related to a real need in the company and work on the project enthusiastically.

ICU, being innovation centric university, prepares its students to be future entrepreneurs. Entrepreneurship courses are given at junior and senior level. Students have to attend some of these courses in summer, sometimes without taking any credit, but being in ICU is a prestigious event and they accept that it comes with some extra inconveniences. The success stories of ICU graduates, and national attention makes it worthwhile to attend this prestigious institution.

Innovation centric affairs of the university are managed through a dedicated vice–rector appointed by the rector. ICU has a special office under the vice-rector of innovative centric affairs that deals with intellectual property related issues. Prospective innovative activities by students or faculty are reported to this office. This office has experts in IP related issues so they can run patent search in the office and can evaluate potential for the innovation in addition to providing help in drafting patent documents. Both students and faculty report the possible innovations willingly to ICU IP office because they know that the office is going to help them to get patents and eventually commercialize the patent through a spin-off company or licensing. ICU has well established rules regarding division of gains from commercialization of the patent. Student, faculty, ICU and even the company involved gets a fare share of the patent. The division seems to favor innovators more than ICU, but ICU officials know that the real gain of the ICU lays in the fact that thorough this process they intend to transform the economy of the country to knowledge centered economy.

ICU has a science park in close proximity to the campus. After the IP issues are sorted out and patent is obtained, spin-off companies are formed. Depending on

the size of the venture, ICU can provide seed funds up to a certain level for the spin-off company. If the capital need of the spin-off seems larger than ICU can handle through its funds, ICU can contact the appropriate government office or the venture capital firm to provide the necessary funds. Once the ICU office asks officially, venture capital firm or the government office approves the funds without much scrutiny. Past records have shown that only one out of ten spin-offs formed by ICU failed. ICU is proud of this low record failure and owes this reputation to good evaluation and follow up by the ICU incubator office.

Once a spin-off company is formed and located in the science park of ICU, incubator office of ICU oversees the activities of the spin-off company. ICU incubator office has about five full time staff involved with all activities of the company. ICU incubator offices involvement in the company affairs is welcomed by the entrepreneur student or faculty, since they know that successful marketing and management is an essential part of having a successful company. Most of the time, management and marketing is not strong points of entrepreneurs, so any help in this regard is appreciated. Business school professors and students also get involved with spin-offs as case studies and give valuable suggestions time to time to the ICU incubators and company officials.

Being in ICU Science Park and being helped by ICU incubator office is a prestigious involvement, so everybody involved tries hard to make it a successful case.

Especially during the initial days of the ICU set-up, ICU administrators and staff worked harder than usual since they understood that they needed several successful examples to get the motivation going among faculty and students. It was hard to get the cycle started in the beginning, but once the cycle started, the system fueled itself and started running at an ever increasing pace. Everybody in the government who are involved with the ICU vision know that this is long term process and fruits can only be reaped after many years, so nobody expects an overnight success.

The reputation of ICU becoming a source of spin-offs helped in several ways. As a result, ICU has attracted better students and better faculty. Faculty improved themselves through involvement with the industry. Industrial companies respected ICU students and faculty more and became more willing to accept co-op students and consult ICU staff for the problems that they face.

All relations between staff, inventors, companies and ICU are well regulated and everybody knows the rules in advance clearly. In case if there are unforeseen problems between different participants, ICU uses an ombudsman, who is neutral to both parties, to resolve possible conflicts. Ombudsman is selected from a trusted person and not necessarily involved with ICU, this way most conflicts are resolved quickly without going into court.

VII. Conclusion

21st century is foreseen as the age of knowledge where the economies will be dependent on innovation and knowledge. The studies indicate that, universities can be very instrumental in setting up the transition from traditional economy to knowledge based, innovation centric economy. In this study, we have described how an innovation centric university can operate through a fictitious institution. It is our belief that such institutions, together with carefully crafted governmental policies nurturing innovation and innovative companies, can transform the society and economy of the country.

References

[1] Global competitiveness report 2001-2002 WEF and Harvard CID, 2002.

[2] E. G. Carayannis, D. Popescu, C. Sipp and M. Stewart, "Technological learning for entrepreneurial development (TL4ED) in the knowledge economy (KE): Case studies and lessons learned," Technovation, vol. 26, pp. 419-443, 2006/4.

[3] Republic of Korea: Transition to as knowledge based economy. World bank institute, Washignton DC. 2001.

[4] Innovative Clusters: Drivers of National Innovation Systems By Hertog, Pim den, Svend Remøe, Organisation for Economic Co-operation and Development, 2001.

[5] S. Monjon and P. Waelbroeck, "Assessing spillovers from universities to firms: evidence from French firm-level data," International Journal of Industrial Organization, vol. 21, pp. 1255-1270, 2003/11.

[6] E. Rasmussen, Ø Moen and M. Gulbrandsen, "Initiatives to promote commercialization of university knowledge," Technovation, vol. 26, pp. 518-533, 2006/4.

[7] E. Carayannis, and D. Cambell, (eds.) Knowledge creation, diffusion, and use in innovation networks and knowledge clusters. A comparative systems approach across the United States, Europe, and Asia. Westport, London: Praeger 2006.

[8] R. Fontana, A. Geuna and M. Matt, "Factors affecting university–industry R&D projects: The importance of searching, screening and signalling," Research Policy, vol. 35, pp. 309-323, 2006/3.

[9] S. Monjon and P. Waelbroeck “Assessing spillovers from universities to firms: evidence from French firm-level data.” *International Journal of Industrial Organization*, vol. 21, Issue 9, November 2003, Pages 1255-1270