Fostering Health Technology Management, Biomedical Engineering & Innovation Competitiveness: Health Technopole CENGETS in Peru

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Abstract — Latin American has a relevant diversity of climate, also a variety of physical, demographic, economic, cultural and social conditions, etc. One of the goals shared by the members of the region is the low investment for development in: infrastructure, research, science and innovation, environmental programs, etc. On 2014, Ministry of Production of Peru stated that over the last years Peru turns to be the regional country leader in: a) growth and taking control of inflation; b) poverty reduction. Peruvian population in average though has not received benefits from these advances. A Technopolis is a conglomerate of capacities that connects research with emergent markets to define solutions and to promote the development of territories (Parry, 2006, Ffowcs, 2007). Development of capacities, design and implementation of innovative proposals connected with the market are key factors to the definition of sustained solutions for health sector. CENGETS at Pontificia Universidad Católica del Perú-PUCP was created on 2005, focusing on development of the national competitiveness on health technology and economic development based on Clinical Engineering, Biomedical Engineering, Health Technology Management & Health Technology Assessment. Through the collaborative network between national and international research centers and expert international organizations and inspired on the model of Technopolis, CENGETS’s grew aligned to the model of networked collaboration (Oh, Yeom, 2012), it promotes the comprehensive approach to technology-based regional and local development in Peru. As a result several local and international organizations: government, universities, non-private and private organizations are collaborators of CENGETS on strategies and programs based on Peruvian Health priorities.

Keywords — Scientific park, Technopole, Development, Innovation, Health Technology, Biomedical Engineering, Clinical Engineering.

A. INTRODUCTION

Latin America region has the following difficulties in common (Kawabata, 2009): (1) Low growth impelled by low productivity, (2) High poverty levels in substantial portions of the population, (3) Poor quality education, (4) A low rate of good quality job creation and a high rate of casual workers, (5) Low risk coverage (collapsing pension, health, accident and disability systems), (6) Low investment in science, technology and innovation, (7) Exclusion of minorities and sharp gender differences. (8) Limited institutional capacity.

Related to Health Technology in developing countries, reaching the full potential benefit of it is difficult. Limited maintenance budgets and weak after sales support from manufacturers and distributors are all too common. The World Health Organization-WHO and various NGOs report high percentage of medical devices are not being used. The reasons include clinicians not trained on the operation or clinical application, facility issues such as poor electrical power or other infrastructure limitations, and disrepair due to no parts, documentation, or trained service staff. Medical equipment principles, operation, safety and support are not taught at most medical and nursing schools.

In the case of Peru, some key-challenges are related to: the relevant level of labor informality; low investment in innovation and inequality related to opportunities for the population as it is shown on Figures: 1 to 4:
Peruvian government understands gradually the relevance and level of influence of Innovation on the process of development required, although Peru keeps behind other countries of the region as Brazil, Chile and Colombia.

A study of the European Union (2014) remarks the following obstacles for Innovation in Peru: 1. Lack of human resources; 2. Insufficient links between the academia, the government and the industrial sector; 3. Need of development of policies and a national strategy to promote innovation; 4. Low level of understanding about the relevance of innovation and consequently investment on related activities by the enterprise.

Despite the gap, statistics from the Ministry of Production of Peru let us observe that over the last years the country turns to be the regional country leader in: a) growth and control of inflation and b) poverty reduction. See Figure 4 and 5. Peruvian population in average though has not received benefits from these advances. See Figures 5 and 6:
Related to STI and Development Challenges and according to Miyakawa (2007), the development of science and technology parks requires applying the correct approach it should be consistent to the context, needs and priorities of the country, developing countries focus mainly on the development of a global market and a global community, the first task for establishing Science and Technology Park in this regard, is the recruit of a team of leaders; speed, scope and scale are key-factors of the process required. The university and the society play a relevant role for the creation of latest science, technology, skill and promoting the industry.

Peruvian public innovation investment is behind on the region and is not consistent to the economic growth stated above. As an initiative to face the challenging context, Peruvian public funds are supported by international funding including World Bank. On the side of the private sector, Peruvian enterprises invest very little in R&D and innovation and there are regulatory challenges to using public funds for private R&D. Peru have developed a National Network to promote Science, Technology and Innovation in the country as shown on Figure 7:

Peruvian government remarks three principal areas to be improved in short and medium term: (i) governance mechanisms, (ii) programs and instruments and funding strategies put in place to provide support to the research and innovation system and (iii) the regional-national dimension with regards to the two previous points.

In this regard the Peruvian National Council of Science and Technology-CONCYTEC states the following priorities to improve Innovation in Peru: a) Creation and improvement of University-industry links, including tech transfer; b) Promote the understanding of the importance of innovation to stakeholders such as politicians and the public; c) Engage the private sector in innovation – both its own innovation, and with government programs and d) Prioritize the right areas for innovation policy investment – particularly to create a sustainable ecosystem. See Figure 8:
Peruvian Health Sector: Overview and Challenges

Peruvian Health system has fragmentation and segmentation. Principal obstacles are: a) the systems operate so independently and without coordination; b) little horizontal integration between subsystems, either for the definition of its obligations (set conditions or insured health services) or production services. Each system operates independently, with its own rules and provider networks, serving different populations. See the Fig.9:

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According to Ministry of Health of Peru-MoH (2016) Approximately, 23.2% of the population has access to the Peruvian Social Security System-EsSalud-health insurance aimed to persons with a salary; 41.2% of the population access the SIS-public health insurance provided by Ministry of Health-oH; an estimated 29.8% of the population has no access to health insurance; 5.8% of Peruvians access other type of health insurances: privates, provided by the army forces, etc.

Principal obstacles regarding health technology are: i) lack of human resources trained and with accreditation; ii) insufficient / obsolete / inexistent norms and regulations; iii) lack of incentives from MoH to promote and sustain the change required. The serious consequences of this situation for Peruvian population demand a change which leads to structural changes on the health organizations also to promote that the health staff: physicians, clinical engineers, administrative and technicians, build technology capacities in Health Technology Management & Planning; Health Technology Assessment; Clinical Engineering; Biomedical Engineering, etc. to improve cost-effective decisions, recognize safety problems before they adversely affect the population, prevent adverse events, elaborate policies, norms, regulations, etc.

B. STRATEGY: Health Technopole CENGETS

A Technopolis is a conglomerate of capacities that connects research with emergent markets to define solutions and to promote the development of territories (Parry, 2006, Ffowcs, 2007). Development of capacities, design and implementation of innovative proposals connected with the market are key factors to the definition of sustained solutions for health sector. Founded by Eng. Luis Vilcahuamán and Eco. Rossana Rivas on 2005 at Pontificia Universidad Católica del Perú, Health Technopole CENGETS is inspired on the model of Technopolis and keep consistency to the environment of a developing country.

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CENGETS made an effective network with health sector in Lima and the regions. Ministry of Health remarked the relevance of his intervention and global expert organizations like World Health Organization-WHO, American College of Clinical Engineers-ACCE, Health Technology Assessment International-HTAi, International Federation for Medical & Biological Engineering-IFMBE, International Union for Physical and Engineering Sciences in Medicine-IUPESM are part of the network.

The results improved the quality of the interventions in health sector through: projects of research, training and education programs and social responsibility activities in the country. See:

According to Nur (2015) different types and degrees of innovation may take place across different stage of development, e.g. Doing, Utilizing and Interacting (DUI) approach. CENGETS’s initiatives are close to this approach. A Linkage & Leapfrogging strategy to incorporate and enhance Health Technology Management-HTM, Clinical Engineering-CE, Health Technology Assessment-HTA and others in Peruvian Health sector is being successfully implemented by CENGETS since 2005 to present. A key component is the sustained multidisciplinary and DUI approach.

Some results of the sustained innovative interaction developed are: creating HTM & CE Units in hospitals, Peruvian Ministry of Health and Social Security System are gradually including Health Technology Management, Clinical Engineering, Health Technology Assessment and Technology Transfer criteria in the norms, national programs, and public training programs; regional governments of Cusco has been involved in several expert seminars and conferences with local and international speakers/collaborators; National Maternal & Perinatal Institute INMP and National Institute of Health-NIH of Peru are gradually incorporating the topics stated on his policies and organization.

Consequently, since 2005 CENGETS has produced a series of events that have helped establish it as a national and regional resource, acknowledged by Health Ministries of 6 countries and WHO/PAHO, including: Co-organizing expert international activities, building and supporting institutionalization of Clinical Engineering-CE, Health Technology Management-HTM, Health Technology Regulation-HTR and Health Technology Assessment-HTA in Peru and for other countries of Latin America region. On 2010, CENGETS received the Amer-
Relevant strong and dynamic members of CENGETS network are: the University of Vermont (WHO Collaborating Centre); the American College of Clinical Engineering, the University of Boston, the University of Orleans, France, UNESCO, IUPESM, IFMBE, HTAi and Kaiser Permanente.

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<tr>
<th>Types of Leapfrog Strategy</th>
<th>Contents in Health Technopole CENGETS’s Application</th>
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<tbody>
<tr>
<td>Leapfrog Development in Macro Level</td>
<td>Time: Using less time to obtain distinctive results appreciated by the government, academic and others local and international institutions;</td>
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<td></td>
<td>Space: Developing collaborative projects in national &amp; regional areas as well as with other countries;</td>
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<td></td>
<td>Quality: Research &amp; Educational activities in line with best international practices; use of advanced educational contents;</td>
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<tr>
<td>Leapfrog Development in Micro Level</td>
<td>In the starting point of Teaching &amp; Training: Teaching and Training not at the actual developmental level, but at the level of potential development, namely, the Zone of Proximal Development (Vygotsky);</td>
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<td></td>
<td>In the growth level of individuals: Promote constant Leapfrogging over the actual developmental level of participants of Educational and Training Programs;</td>
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CENGETS focuses on improving the quality of decision making about health technology and to improve competitiveness on: Clinical Engineering, Healthcare Technology Management, Health Technology Assessment, Management of medical devices, Framework of Medical Devices Regulation, Qualification or training in Healthcare Technology, Management of Healthcare Quality, Development of appropriate technology, Promotion of a national: a) industry for medical devices; b) health basic services offer. CENGETS’s approach is shown in Figure 13:

![Fig.13. “Science, Technology, Innovation & Development Approach applied by CENGETS”, R. Rivas, 2016. Adapted from “Challenges to International Data Sharing: the Role of UNESCO, Kalonji, 2011.”](image1)

The focus is on promoting and inspiring the Change in health sector through the creation and enhancement of Social Capital. The process of creation of Social Capital required is taken place then in the university and also in the society from the university, (Baudassé, Rivas, 2013). See Figure 14:

![Fig.14. “General Model of Social Capital Creation”, Baudassé, Rivas, “Social Capital, Science Parks and the University Challenges”, 2013.](image2)
In this regard, four are the mechanisms developed and aimed to the multidisciplinary health staff: 1) Conducting capacity-building; 2) Developing pilot projects; 3) Facilitating knowledge transfer and 4) Networking as shown on Figure 15:

<table>
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<tr>
<th>Mechanism</th>
<th>Description</th>
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<tr>
<td>Conducting Capacity-Building</td>
<td>Aimed to decision-making, policies, regulation and projects about Health Technology, Biomedical Engineering, Clinical Engineering, Health Technology Assessment, Biotechnology, etc.</td>
</tr>
<tr>
<td>Developing Pilot Projects</td>
<td>Responding to the request of Ministry of Health-Med, National Institute of Health, Social Security System-EsSalud, Regional Government, etc.</td>
</tr>
<tr>
<td>Facilitating Knowledge Transfer</td>
<td>Expert courses, Seminars, Workshops, Advisory, etc.</td>
</tr>
<tr>
<td>Networking</td>
<td>Being a global facilitaion for collaboration with and a collaborator of Ministry of Health, National Institute of Health, Social Security hospitals, Chamber of Commerce of Lima and others a member of National Technical Committee to developing National Standards for Health Sector.</td>
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</tbody>
</table>

Fig.15. “Mechanisms aimed to Multidisciplinary Health Staff”, Rivas, 2016. Adapted from “Role of Science Park and Technology Incubator in fostering innovation in postindustrial regions” by Nur, 2011.

C. RESULTS

The following is a List of results achieved by CENGETS:

1. **Promotion, contribution and strengthen NIH and MoH planning according to Peruvian Law to Improve Health Sector through HTM & HTP and Development and Transfer of Technology in Health Sector.** Transfer for Peruvian Health Sector-May 12-14/2015 International Workshop; 1st HTM & HTP and Health Technology Transfer Nov.17-Dec.15/2015 Course for NIH.

2. **Strengthen the development of policies and operational capabilities at NIH and MoH: Human Resources Development Policy, Regulation, plans and programs related to HTM & HTP and Health Technology Transfer in Health Sector.** References: 1st Health Technology Transfer for Peruvian Health Sector-May 12-14/2015 International Workshop; 1st HTM & HTP and Health Technology Transfer. Nov. 17-Dec.15, 2015 Course for NIH.

3. **Strengthen the proposal and policy, regulatory and research at NIH and MoH related to the effects of exposure to heavy metals in children and pregnant women:** Reference: 1st Health Technology Transfer for Epidemiology Research and Public Health in Heavy Metals-May 6-8/2015. International Workshop.

4. **Building local capacities on Innovation, Biotechnology, Health Technology Management and Planning:**
   - Reference: “Innovation, Health Technology Management & Planning” sponsored by Chemical Professional College of Peru-CQFP and co-lead by the Univ. of Vermont; Course; October 2016.

5. **Creation of Undergraduate Biomedical Engineering Program:** between Pontifical Catholic University of Peru-PUCP and Universidad Peruana Cayetano Heredia-UPCH with the collaboration of the University of Vermont USA, the University of Boston, IFMBE and the sustained participation of CENGETS. The project started on 2011; PUCP, the best Peruvian university in Engineering and UPCH, the best Peruvian university in Medicine announced the program on September 28, 2016; the studies will start on 2017.

6. **International Internships in Clinical Engineering:** Since 2005 to present, Health Technopole CENGETS coordinates with the University of Vermont USA a collaborative program of internship for PUCP students; they receive a Health Technology Management & Clinical Engineering training program and work at American hospitals, next to the stage they return to work in Peruvian health sector.

D. CONCLUSIONS

CENGETS’s approach is centered on the population of Peru; one of the best lessons learned through more than 10 years of sustained work in private and public health sector is about the value of enhance and inspire the change through the human resources and decision-
making agents, this is a dynamic on which Social Capital and Innovation have distinctively roles.

The convergence between CENGETS’s goals and the future activities stated by PUNKU Scientific, Technology and Innovation & Social Park at Pontificia Universidad Católica del Perú-PUCP: a) Innovation-Development & Research Projects; b) Innovative Services as one of their principal lines of action; c) Training, and Dissemination by seminars, conferences, workshops, etc. indicates that the future synergy between CENGETS and PUNKU will provide unique and positive dynamics in benefit of health sector and Peruvian population of Peru.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES


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