

INCLUSIVE DEVELOPMENT THROUGH INNOVATION: SOLUTIONS FOR PUBLIC HEALTH ISSUES

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Abstract- *Inequality and wealth distribution have been widely researched. However there is a lack of attention of these issues within the field of innovation studies. Recent trends on innovation studies have pinpointed the necessity to strengthen research programs about innovation for disfavored populations around the world. A recent research area has focused into inclusiveness and social development. Two main orientations have been identified: (i) Innovation requires involvement of people affected in the demand definition, as well as in the solving of processes to become an inclusive innovation problem. (ii) Inclusive development is oriented to identify and establish solutions for problems that affect marginalized populations. In addition we found a variety of categories to study the problem: inclusive innovation, innovation for inclusive development, innovation for social development, innovation for the population at the bottom of the pyramid, among others. This research explored four Mexican innovation experiences in the health sector from the perspective of inclusive development. Imitation, training and low cost studies and solutions were key points in these cases. In the health sector, it is very difficult for marginalized populations to collaborate extensively in the processes and solutions to solve their medical problems. To find these solutions, the participation of experts (researchers and physicians) and the role of intermediate organizations become very relevant: universities and public research centers, non governmental organizations, associations and local governments are all fundamental to achieve innovation efforts and develop knowledge to solve health demands for disadvantaged populations. This article presents a variety of participants and crucial processes like learning and social capital construction as key points of innovation for inclusive development.*

Keywords - Innovation, inclusive development, learning, social capital, health sector.

I. INTRODUCTION

The aim of this paper is to analyze the processes of development of innovations oriented to inclusive development in the Mexican public health sector. The conceptual framework considers collaborative learning and social capital, participation of different actors such as people that have social or health problems and demand a solution, non governmental organizations (NGO), intermediary organizations, higher education institutes (HEI) and public research centers (PRC), as well as the government at different levels. The research questions are two: What are the stages of development of innovations aimed at inclusive development and how these phases are built up from collaborative learning and involvement of different actors? And, how does different experiences of innovation in Mexican public health sector allow us to shape (or to validate) an analytical structure consistent for explaining the processes of innovation aimed at inclusive development?

The evolutionary economics has established as mainstream in the study of innovation in recent decades [see for instance 6, 22, 23, 27]. From this perspective, one of the principal thesis is that technological change and innovation

generate industrial development, economic growth, and sustainable development. This is valid for developed countries but, as [31] argues, the correlation is not always positive in the time. Countries relatively more rich (Europe, United States, Japan) are relatively more innovators [see for instance 3].

However, for developing countries, the effects of innovation on development and growth are different, great percentage of people suffering high levels of poverty, marginalization, and inequality, these problems would be considered as ways of social and economic exclusion. This exclusion has been analyzed from theoretical frameworks other than orthodox, several authors such as [25, 26, 30, 35] have tried to explain the processes of this exclusion and propose alternative models of growth and development with a better distribution of income and social welfare.

After this introduction, the second section discuss the conceptualization of innovation for inclusive development. The concepts of collaborative learning and social capital, and the role of intermediary organizations are central analytical categories to analyze the process of innovation for inclusive development. The third section discuss the cycle for solving problems of social inclusion as theoretical proposal. The

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fourth section describes the research design and methods. The fifth section (results) presents and analyzes the cases. Finally, discussion and conclusions are presented.

II. LITERATURE REVIEW: THE CONCEPTUAL DIVERSITY OF INNOVATION FOR INCLUSIVE DEVELOPMENT

The concept of innovation commonly accepted by the academy refers to the introduction of new (or significantly improved) products, processes, services and marketing in the practices of the firm. Innovation supposes the creation of new technological knowledge and therefore the design and development of outputs, traditionally based on R&D activities, in the context of maximizing economic benefits. In aggregate, innovation should influence on competitiveness and productivity of firms, regions, and economic growth. Authors as [3] argues that today's richer countries (Western Europe, United States) are relatively more innovative. Although this correlation has been tested in various points in time, there are other deep causal elements (social, political, cultural, economic, environmental) underlying the processes of innovation, regional development, and growth.

In this context, we wonder if the concept of innovation captures correctly the processes occurring in firms and other organizations in countries relatively less innovative, for example, Latin American countries. It is often questioned whether the firm is the only agent of change in the processes of innovation, whether innovation is predominantly based on R&D, whether the market is the sole determinant mechanism, whether the schemes of private appropriation are compatible with collective appropriation. We also wonder if other organizations such as NGO, government agencies, communities or groups generate innovations; or whether a product, process or service (new or improved) that do not go through the market mechanism could be an innovation (for instance, drugs, process medical, agricultural techniques, improved seeds, and so on, developed by HEI, PRC or hospitals, and not by the firm). In addition, there are a variety of questions and little evidence documented to characterize the innovation processes in groups, communities and organizations other than firms; such that allows us to understand, measure and evaluate the innovative activity at different levels and degrees of impact on the market and society with a more inclusive vision.

Innovation for Inclusive Development

Inclusive innovation is defined from several ways but it needs an analytical homogeneous framework and a wide debate about the concept. [29] identifies a change of paradigm since the TICs introduction in economy and society. TICs have changed the conditions where innovation happens improving employment opportunities, wealth creation, and eventually advancing quality life. This paradigm has included the study of innovation for and by the poor and the weak. Some scholars that have been studying this phenomenon coincide that there is an unsatisfactory conceptualization. The concept has been defined as innovation for inclusive development [3, 15], innovation oriented to social inclusion [1, 2, 16], inclusive innovation [10, 11, 12], inclusive development [35], innovation for inclusive growth [12], socially responsible innovation, innovation for wellbeing [24], or innovation for the bottom of

the income pyramid (BoP) [30]. These scholars coincide that this concept implies designing and developing products and services aimed to solve problems for the poor population but also, in some approaches, the key point is the involvement of the affected population on the problem recognition and solution.

Although there are a wide variety of concepts, there is a significant coincidence of purpose. One definition of starting and relevant to this paper is from [12], who conceptualizes inclusive innovation as the development and implementation of new ideas to create opportunities that raise the social and economic welfare of the population deprived of their rights. This population is at the base of the pyramid [see 30], or in poverty. These authors believe that inclusive innovation can be a process and at the same time a result. This duality implies a cyclic causality, on the one hand, it can be the means to achieve other stages of development, an increase in the levels of welfare and quality of life, and not only better levels of income and employment. On the other hand, it can also be the result starting other complementary elements such as the development of institutions and policies. In either case, the authors refer to different sub-processes such as learning, coordination and collaboration, accumulation of capabilities, among others.

Some researchers highlight four aspects that shape the inclusiveness [10]: 1) The goals of innovation needs to have its focus on the needs of poor people. 2) This segment of the population needs to be involved in the development of innovation. 3) They need to have the capabilities to adopt innovation. 4) Such innovation has a beneficial effect on their lives. From these aspects arise some questions: how far can sectors of the population be involved in the development of goods and services? Is it possible to involve the poor people in the processes of creation or adaptation of knowledge? If knowledge is a task performed by experts, what extent does this condition make a concept of innovation highly restrictive? In the field of innovation, the experts are in charge of the development of new knowledge, patents and hopefully, innovations in the market.

It is essential to establish actions in order to link research programs and innovation with social inclusion problems [1]. These authors argue that a problem that has not been identified as such by the population affected, is not visible and therefore it cannot be subject of research. Even though, in the field of health -as in many others- the problems are not necessarily identified by subjects or patients but by specialists; the population affected have a central role adopting the innovation, as pointed by [11].

Table 1 presents some proposals that have allowed conceptualizing and, in some cases, empirically addressing the analysis of innovation for inclusive development. Even considering the differences among them, there is a common concern about the inclusion of the poor population on the benefits of innovation. Some proposals [12] equal inclusive innovation with innovation for inclusive growth. This approach remarks government participation through public policy design and the removing of structural barriers to foster inclusion. Some authors [4, 15] also address to the understanding of institutional arrangements and public policies to achieve inclusive development or social inclusion. [10] highlight the role of national innovation systems, the strength of institutions and the central role of intermediary

organizations. At a micro-level, research explores the role of actors: innovators as drivers of the process [17], or people with social problems or disfavored populations that recognize a demand to be fulfilled by an innovation [1]. The approaches to study the inclusive innovation comprise a wide range of issues. Particularly we identify three that are very useful to study these processes in the health sector: the institutional issues (arrangements, institutions, barriers, incentives, policies), the learning processes and social capital construction, and the participants in the process (intermediary organizations, innovators, universities, experts, and disfavored groups).

From the concerns raised by these authors, we define inclusive innovation as a series of processes of adaptation, creation and diffusion of products, processes and services through the practices of organizations of both market and non-market. This kind of innovations is connecting with the needs of the population without resources. These processes can be complemented by cumuli of information and traditional knowledge (for example, historically based on particular structures of governance and governed by *customary practices*) and cumuli of scientific knowledge, or between local knowledge and knowledge created in other contexts and for other purposes. This complementarity shapes a new directionality and technical and cognitive intentionality for the designing and development of products and services adapted to the contextual needs of certain populations, groups, organizations or regions.

It requires a complementary analytical framework at the micro level in order to understand the processes of creation, diffusion and use of knowledge. This is consistent with the definition of social innovation from the Schumpeterian perspective that [37] done, he refers to the social innovation as a combination between invention and the generation of value. If an innovation has impact and is sustainable, it must create value. The value of social innovation is established in terms of the social impact it can have (healthy population, economic opportunities, sustainability, justice and equity) and not as rate of return to investment in innovation.

TABLE I. CONCEPTS OF INCLUSIVE INNOVATION

| Authors | Concept | Proposal |
|--------------------------|---|---|
| George et al (2012) | Innovation for inclusive growth or inclusive innovation: innovations that create or enhance opportunities to improve the wellbeing of those at the BoP. | Remove economic, geographic, social and structural barriers. Central role of public policy and governments. |
| Foster and Heeks (2013) | Inclusive innovation: means by which goods and services are developed for people of lower income. | Adaptation y diffusion. Intermediary organizations. National innovation systems. Institutions. |
| Alzugaray, et al. (2012) | Problems of social inclusion: problems in socially excluded groups requiring accessible solutions | Participation of people that have social problems. Recursive circuit that starts with the |

| | | |
|-------------------------|---|---|
| | with new knowledge. | detection of problem until its solution. |
| Halme et al (2012) | Innovation for inclusive business. | Innovators as drivers of the process. The role of pro-poor entrepreneurship. |
| Conceição et al. (2001) | Inclusive development: spread prosperity across the globe considering the specificities of each community including their problems. | Social capital. Collaboration. Learning. Institutional arrangements. Science and technology policies. |
| Guth (2005) | Innovation for social inclusion: innovation to reduce the polarization between innovative and non-innovative regions through regional policies. | Systemic vision. Institutional learning. Individual learning. Social capital and trust. Social and economical cohesion. |

Some Basis for Understanding Inclusive Innovation

The proposals for conceptualizing innovation aimed to social inclusion imply significant differences, but also they have common analytical concerns. We can rescue two: learning related with building of social capital and the participation of diverse actors such as beneficiaries and intermediary organizations, usually not considered in traditional patterns of innovation¹. This could be added to the model proposed by [1].

Collaborative Learning and Social Capital

In this context, we emphasize the effects of innovation on income distribution, on the production of social benefits and improving of the quality of life of poorest people, compared to economic growth aimed by large firms. This additional intentionality requires the recreation of cumuli of information and knowledge, the participation of various actors as well as the combination of dynamic and learning processes rooted in local institutional structures, and the expected outcomes under a social logic and not just under economic logic.

Some authors have paid attention to the ways in which organizations and regions shape paths of development and economic growth from collective learning processes, organizational learning and the creation of social capital [3, 15]. The causal relationship between learning and knowledge accumulation (due to property rights) and its impact on development explains the thesis that innovation occurs with more dynamism in developed countries, and in these countries there are a better distribution of benefits due to the construction of social capital [3]. The problem is the weakness of the processes of diffusion and socialization of knowledge toward developing countries. In this sense, inclusive development is explained through learning processes globally integrated, in contexts of social and

¹ We consider institutional arrangements, learning, and policies also as enablers of innovation for inclusive development but it is not included in this paper.

institutional interactions that govern the behavior of individuals and organizations. For some researchers, learning can be understood as social capital [3, 15], and trust, reputation and reciprocal action are key factors to develop it. In this process collective action and benefits are constructed.

For [15] inclusive innovation involves a systemic view of innovation, collective learning and social capital. This learning is a kind of social capital because it requires a minimum of trust among actors who exchange knowledge, and it is necessary a certain level of social and economic cohesion to implementing innovation processes. In that sense, social capital depends on connections and relationships between people and organizations that emerge from networks and institutions, which in turn fostering the learning and collaborative innovation [3]. Likewise, other researchers [15] argue that organizational learning requires a minimum of institutional trust.

From the perspective of innovation for inclusive development, collaborative learning is highlighted by the participation and involvement of different stakeholders (beneficiaries, intermediary organizations, producers, and so on) on the processes of creation, adaptation and diffusion of products and services. Therefore, collaborative learning is defined as the acquisition of skills and knowledge that, in complementary with other cumuli of knowledge, transform the behavior of working groups and organizations. Furthermore, the institutional learning is crucial in this analytical perspective. It means the acquisition of skills and knowledge to manage and implement the institutional change; its results are cumulative and uncertain. The basic norms, rules, conventions, habits and values of society are underlying in those processes, such that learning is generated at individual, group, organizational, regional or national level.

Actors in the Process of Inclusive Innovation

Innovation studies have focused mainly on large firms. Although HEI, PRC, producers, financial institutions, and others actors participate in the process of innovation, the central actor is the firm. But, from the perspective of inclusive development, other actors become relevant, such as the intermediary organizations, universities, the population affected, NGO, among others. However, the explicit participation of certain actors depends on the innovation models promoted.

How could actors with lack of resources be included in the innovation process? And how could they obtain benefits from the innovation? This depends on the model of innovation. For instance, in the linear model of innovation the diffusion process is unidirectional, the actors are receivers of innovations and in some cases they play an active role in the development of products. A second model considers the innovation as an interactive process, in which users or other agents play an important role in the innovation process [36]. The diffusion process can be unidirectional and in some cases the users can be a pro-active agent. A third model is based on networks of collaboration, in which organizations such as HEI, PRC, NGO, users, government agencies and investors participate in the processes. In this model, the innovation arises from the interaction of different knowledge sources, internal and external to the organization, and there is a complementarity of skills and knowledge [7].

Some researchers identify two channels to foster inclusive innovation [5]: as a process of *inclusiveness in terms of problems and solutions* or as a process of *inclusiveness in the process itself*. The first one implies development, production and distribution of products adapted to the needs of poor population. This channel is more or less common and has been documented in several moments. The second one implies participatory exercises among actors for designing and development products, processes and services. This channel is less common and its complexity is greater. The demand-driven innovation implies knowing all the microeconomic variables difficult to detecting with conventional market studies.

Innovation for the inclusive development requires the participation of different actors that traditionally were not integrated. A significant role is played by those identified as “transformers actors” or intermediary organizations that play the role of interfaces between the neediest people and the organizations responsible for the production and distribution of products. Thus it begins a process of engagement between the values and customs, needs and problems on real and contextual needs of poor people. Intermediary organizations facilitate the linkages between the main actors in an innovative network. They contribute to reducing the 'information gaps' and facilitate cooperation among stakeholders by providing information on the benefits that each actor can offer overcoming systemic failures. The role of these organizations must strengthen a particular logic of interaction between those involved in coordinating other forms of production, distribution and appropriation of profits, in many cases they must be institutional entrepreneurs [19, 20].

While this analysis emphasizes the role of intermediary organizations, which may be different types of actors (NGO, HEI, PRC, government agencies, and so on), the relevance and participation of other actors in the innovation process for inclusive development is not obvious. This aspect is detailed in the following section.

III. CYCLE TO ANALYZE INNOVATION FOR INCLUSIVE DEVELOPMENT

The study of innovation for inclusive development presents challenges of conceptual, methodological and empirical order. Besides the diversity of concepts, some proposals avoid the context (policies, poor demand, weak institutions, and so on) in which problems and solutions occur. In other cases, the discussion focuses more on characterize inclusive innovation as incremental innovation, through which it is possible to solve problems of disadvantaged groups. [1] proposed an overview of the whole cycle of problem-identification-research-effective solution in five phases. This cycle is shown in Table 2. In the first two columns the proposals by the authors are showed, in the third column critical proposals to expand the scope of the model are included, in the fourth column other relevant stakeholders for each one of the phases identified according to the points made in this article are included. These authors reiterate that this cycle is not linear; it could have cuts (short-circuits) and flows backward.

It has been argued that the problem of social inclusion becomes such when it has a voice, it is to say, when the problem is expressed and received by a particular audience

[1]. This means that the problem is connected with the objectives of the people. This allows them to join efforts of different actors; it would not be possible if the problem were not visible. It must be emphasized that not all problems of social inclusion require research to be solved. In some cases they require educational programs in different areas, infrastructure development, public policy, local regulations for transnational and local firms, open diffusion, new intentionality and directionality of the knowledge created, and so on. Therefore, in this proposal we consider that a better term is a research or innovation for social inclusion or inclusive development.

We start from the idea that the generation of social benefits can include broader and relevant problems to reduce inequalities in developing countries. Research can be original, of border, or of imitation and adaptation. In the same way the innovation of product, process or service can be incremental, but we are seeking that the innovation solves problems that are affecting disadvantaged sectors of the population. For that it is necessary to make explicit the linkages between research, innovation and the purpose of this innovation in order to solve social problems of that people, beyond the generation of richness. The flexibility of the model is central to understand inclusive innovation diversity patterns.

TABLE 2. CYCLE FOR SOLVING PROBLEMS OF SOCIAL INCLUSION

| Phases | Activity/Actors | Proposal | Other participants |
|--|---|--|---|
| The problem of social inclusion is identified. | Affected population recognizes the problem. Actors: affected population. | Other actors different than population affected could identify the problem. | Specialists, Researchers, Government at different levels. HEI and PRC, |
| The problem requires a solution. | The problem has "voice" or it is visible. The population demands a solution. Actors: affected population, actors connected with the problem, NGO, government. | The demand can be real and/or potential and be done by specialists, by affected people, intermediary organizations or others. | Specialists in public health, government, HEI, PRC, physicians of first level of attention, NGO, and so on. |
| Research is done about the problem. | Researchers establish a direct dialog with population that suffering social problems. Actors: others researchers, policy makers, organization of | Complex problems and its solutions in the health sector could be exhibited and claimed by specialists or intermediaries, and not just by | Hospitals, researchers, government, physicians of first level of attention, HEI, PRC. |

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|--|---|--|---|
| | civil society, mass media. | the people affected. | |
| A prototype is produced and the product, process or service is scaled. | The solution is scaled and researchers or intermediaries seek to solve it with government intervention. Actors: researchers, producers, and government. | HEI or PRC can play the role of intermediary organization, articulating all the actors, shaping programs, and so on. | Researchers, developers, physicians, affected population, HEI, PRC. |
| Effective solution is outlined. | It is created a technical solution, it is diffused and adapted to the characteristic of the population affected. Actors: producers, government, NGO. | HEI or PRC as intermediary organization. | Nurses, physicians of first level of attention, mass media. |

Source: Own elaboration starting from [1].

IV. MATERIAL AND METHODS

The research methodology is based on an exploratory multiple-exploratory case study. The strength of this strategy lies in its capacity to include data from a variety of sources of evidence such as direct observation, systematic interviews, archival data and other documents. The research strategy allows us contrasting data for similarities or differences.

The central elements of case study are: research question, theoretical proposition, and the unit of analysis, logical linking between data and proposition, and criteria of evaluation of that proposition. In this paper, the cases are the entities where the project is developed, the unit of analysis is the project associated to a set of "unique cases", which are performed in different contexts. The cases were selected by two criteria: because they are representatives in its respective contexts, and because they provided us abundant information related to the analytical categories and the proposition.

In-depth interviews were used as the main instrument for collecting data and information. We interviewed coordinators and project leaders, as well as members of research teams. The fieldwork was done in Guerrero, Chiapas, Oaxaca and Mexico City, between 2012 and 2014. Data analysis was made with a reflexive interpretation, that it is to say, induction and sensitive interpretation were used to establish the meanings of observation and information obtained [21].

The cases are representative and illustrate differences and similarities in the development stages of the innovation cycle for social inclusion. Considering the criteria for assessing the theoretical and empirical propositions, as well as the evidence and analysis from all the cases, we can broad the discussion of the development of products and processes for social inclusion. It is important to mention that the collection of documentary sources, mainly in the cases from Mexico City,

was fundamental for integrating two of the cases that are reported. Particularly, documentary sources were required because the processes of creation and integration of knowledge (prior to the potential innovation) for these cases were developed over more than a decade.

V. RESULTS AND DISCUSSIONS

The four cases show the solutions development processes through identification of local problems that affect disfavored population. In some of the cases, the affected population participates in some part of the cycle of problem solution (eggs against obesity). In other cases is more relevant the role of intermediate organizations that have the expertise knowledge to identify complex health problems (like in telemedicine). Also there are cases where universities have a central role because they have the human capital, knowledge and instruments to assess and detect problems affecting poor population or as they called it, diseases of poverty. Multinationals are not interested in making drugs to markets where the economic benefit is very low. The cases explore the relevance of activities, programs, and attention policies assembled through collaboration with HEI, PRC or intermediate organizations (NGO, small firms, and so on), but also with local and state governments.

Case I. The Orphan Drug Program

The origin is found at one public university. The researchers interest lets to attend problems of marginalized people in Mexico. Through the links created with hospitals and public health institutions they built a bridge among knowledge development, drug production and patient care. The university program is opened mid eighties under the name of "Technological development for elaboration and purification of orphan drugs and excipients from diverse backgrounds". This program has the goal to attend health problems for the poor Mexican population in marginalized regions. Also to attend health problems of low incidence rate, or diseases where multinational pharmaceutical companies are not interested because of the low rate of economic return². The group has been working over new uses of old and patent expired pharmaceutical principles, one example is Thalidomine and its use for leprosy.

Since early eighties a group of researchers began the exploration around diverse drugs. They obtain some patents and strength their knowledge capabilities over health problems that affect marginalized people. The group worked initially with low cost chemical components or drugs with expired patents. The reason that influenced their selections was the economic restriction for university research in the area. Autonomous research and capabilities development lead the group to find new applications of patent free drugs.

This program has evolved and enriched with the integration from researchers and doctors from organizations linked directly to health attendance (hospitals, public health institutes, clinics, and so on). The group is still working over

drugs for unusual diseases that appear in poor and marginalized communities in the country³. Low cost research and with the correct links it is possible to attend problems like leprosy. In Mexico, some diseases are associated with socio-economic conditions. This perspective could be very useful, particularly if this kind of programs have public support from university and local and state governments. The application of Thalidomine to attend leprosy in Sonora and Sinaloa patients (in localities with high temperatures and marginalized) happens through relations developed between university and the Dermatological Center Ladislao de la Pascua, in Mexico City. Through this research program, the Thalidomine is synthesized and manufactured. The group used a small reactor to produce the drug to satisfy demand of affected population. When the director of the dermatological center changed the link developed disappeared. The new authorities are not interested to continue the collaboration⁴.

This case exemplifies how the innovation for inclusive development began with the capabilities created at university. The research group strength a supply of knowledge but because of their research area, they want to use that knowledge. The researchers interest took them to look for collaboration with health institutions in order to solve particular problems. There were set up collaboration agreements to face the medical problem and manufacture the drug. Even though the collaboration was not supported widely by the university or government; the life of this kind of programs is limited to the individuals' participation. This case of innovation for inclusive development shows that under the linear model of knowledge production and with universities being the processes coordinators in problem identification and solution generation, it is possible to offer convenient responses to health issues that affect marginalized population in Mexico. In addition this case shows the lack of support and program formalization of programs through public policies and programs at the health institutions to attend this kind of programs.

Case II. Artificial Heart for Temporary Replacement

This work began with a company request to a public university research group to develop a device to substitute a human heart for a period of time. A well-known researcher in a Mexican public university has developed over time huge capabilities to construct medical devices. A private company looked for this researcher in order to produce this heart device. The company was looking to commercialize the product but also was looking to diminish the prices, because market prices were out of reach for markets in developing countries. A market request is presented to the university team. The final product is a medical device with a cost of 5 thousand dollars instead of 50 thousand dollars. The first surgery to implant this device was realized in 2012 at the public hospital *Siglo XXI*.

² Interview to Dr. Luis Camilo Ríos from Metropolitan Autonomous University at Xochimilco: "UAM develops patents about dapsona drug (Desarrolla UAM patentes sobre el fármaco dapsona), in UAMEROS, February, 22nd 2013. <http://www.uamero.uam.mx/UAMeros/insides/newsb.aspx?pid=2253>

³ Interview to Dr. Marina Alttagracia Martínez, at UAM weekly newspaper, vol. XIX, November 12th, 2012. http://www.uam.mx/semanario/xix_12/files/assets/basic-html/page8.html

⁴ Interview to Dr. Marina Alttagracia Martínez, at UAM weekly newspaper, Vol. XIX, November 12th, 2012. http://www.uam.mx/semanario/xix_12/files/assets/basic-html/page8.html

Research and technological development to produce medical devices is extremely expensive. University budget for research, and public research programs are not enough to support this area. Then the traditional research model where research is sponsored by government is not possible. Heart device required the integration of a research consortium with public-private financing participation (Ministry of Economy, Science and Technology National Council, and a firm called Vitalmex principally but not exclusively). The R&D process that includes: research, design, building, testing and sanitary validation required more than 100 million pesos during a period of 10 years⁵. Innovamedica was a firm created to link different actors and to manage research processes and economic resources. The firm was opened in 2000. The enterprise performs activities like an intermediate organization. It is a vehicle to link firms in biomedical industries, but also articulates relations with different HEI, PRC and government. It was the way to make more efficient the process. The new firm obtained venture capital and committed its future royalties derived from its patent portfolio, and benefits from research services and consulting⁶. It is a *start-up* cultivated at university but it could not be opened with university participation because of regulatory restrictions. Innovamedica worked through 10 years, it was granted with 25 patents, it offer postgraduate scholarships and it had almost 50 high qualified employees.

This case shows how extended must be collaboration networks in order to produce an invention with a decisive potential to solve main public health problems. The cost of the artificial heart in global market is so expensive and inaccessible for a public health system usually overwhelmed. Innovamedica performed as an intermediate organization to articulate financial fluxes. Also it fosters knowledge development, it nurses alliances with distributing companies, and established links with public hospitals interested on the invention. Then, the users of innovation are very close since the beginning of the research process. Innovamedica link public-private contributions and strengthen alliances with multinational firms interested on the invention. However, structural changes at global firms interested on the invention, took them to the appropriation of knowledge and devices produced out of the formal contract. As a result Innovamedica was disintegrated and began a legal conflict. Innovamedica knowledge property was returned and the relations with Mexican public hospitals were strengthened. The next step is the extended manufacture and commercialization.

This case explored a more complex relationship because of the diversity of participants. Mexico has a high prevalence of heart diseases. Diabetes and hypertension are associated conditions. Medical devices have a huge price and the prevalence of the problem was some of the motives that took an entrepreneur to propose the project. Then, a firm identifies

a market problem (demand) and presents it to a researcher. In the process to support the investigation, it was created a new firm. This company, named Innovamedica, was in charge of coordinate a wide set of different public and private organizations (government, S&T council, HEI, PRC, enterprises, and so on). The result is a low cost device, in market terms. The first time to be used was 2012 in a public hospital. The case explores an intense collaboration cycle, with problems to consolidate links in the long term, but even tough, the final result was a successful prototype. Now they are looking to arrive to manufacturing stage and massive diffusion to public and private hospitals. Low cost production and market price closes this solution to the population. This invention was developed at the university and with a high potential to solve problems at public hospitals. The disease was present, a solution was developed and will benefit to disfavored population in Mexico.

Case III. Tele medicine (Oaxaca, Guerrero and Chiapas)

Mexican health system has major challenges to face: a demographic change and population aging of a quarter of the Mexican population in 2050, an epidemiological change which will imply a higher prevalence of non-communicable diseases, in recent years the prevalence of diabetes mellitus in adults has increased to 14.4%, one of the highest in the world [13]. Moreover, the geographical dispersion and the size of the localities are still a limitation for the provision of health services, and medical infrastructure remains centralized, around 50% of public hospitals are concentrated in 9 states of Mexico [34]. Although the health care reform was done in 2012 17.7% of the rural population was not entitled to health services [14].

In order to attend some of those problems, telemedicine technology (TM) helps to increase the cover and quality of health care services. This technology has been implemented in several medical units in some regions of Mexico. Particularly, SSA (for its acronym in Spanish; Ministry of Health) has used this technology in southern Mexico (Guerrero, Oaxaca, Chiapas) to attend poor people. Telemedicine is composed of hardware, software, and medical peripherals shaping a system in order to transfer medical knowledge and information in the form of data, text, image, and sound from one medical unit to another one, when physical distance is important.

Telemedicine works in networks. Each Mexican state has one network of telemedicine and four principal actors collaborating: hospitals of high specialty located in urban localities, clinics or rural medical units, patients, and the regional agency of telemedicine (RATM). The last one is a kind of intermediary organization, ñomlomg through TM the health needs of disadvantaged populations with hospitals of secondary and tertiary level of attention, coordinating and managing medical services, and integrating medical and ICT technologies.

RATM helps to the patients to transfer their *voice* to the hospitals of secondary and tertiary level health. When patients are sick, they visit a rural medical unit in order to obtain a diagnosis, if the sick requires attention from a specialist, through TM the patients are linked with a hospital of high specialty. What does this imply? First, the people do not need to move from their rural communities to urban localities in order to be diagnosed opportunely, if it is

⁵ See Innovamedica: la empresa científica, Zósimo Camacho, *Revista Fortuna*, Año II, No. 25, February 2005, www.revistafortuna.com.mx/opciones/archivo/2005/febrero,12.06.13.

⁶ Sacristán, E., Vinculación academia-empresa y el caso de Innovamedica, in *La tecnología Mexicana al servicio de la industria. Casos de éxito*, Regional Conferences on Competitivity, 2005-2006, Foro Consultivo Científico y Tecnológico, February, 2007.

necessary the medical treatment and monitoring are carried out through TM in their localities. Some diseases such as obesity, diabetes, dermatitis, and others, as well as common diseases could be diagnosed, treated, monitored and evaluated through this technology.

Second, this service is of low cost for the patient and for the hospital. For the first one, costs of health care services, transport, food and lodging in cases when they need to waste one or more days in the hospital, diminish significantly. For the second one, the cost of operation (diagnosis, treatment and monitoring) reduces because of less saturation of the hospital. On the whole, this technology helps to the patients to obtain timely access to highly specialized medical services and to the system to expand healthcare coverage.

Third, an important aspect is the dynamic of socialization of experiences between specialist physicians (from the hospitals of high specialty) and general physicians (from the rural medical unit). The last ones could generate greater capacity in to make better decisions in the various activities of medical practices. While levels of learning in each project have been different, this case shows that, generally speaking, the practice of telemedicine in Mexico has had positive effects. Certainly telemedicine allows to the rural and poor population greater equity in the access to specialty services for the rural and poor population, it allows pertinent diagnosis and treatment, and expands healthcare coverage in rural and indigenous localities.

Case IV. "Ranch eggs" project (Puebla)

The Produce Foundation of Puebla (FUPPUE, for its acronym in Spanish) is a civil society organization managed by farmers. It was created in 1996 as a not-for-profit association of farmers. Its aims are to promote and facilitate the process of transferring technology from the HEI/PRC to farmers, to develop and finance projects that benefit the rural sector in terms of promoting the integration of small farmers to the productive chains, during in its evolution it has incorporated other lines of action such as combat food poverty and malnutrition. It focuses on communities suffering from high and on developing an entrepreneurial vision and culture among the rural farmers, drawing them towards a knowledge of technological innovation that could improve the profitability of their lands in order to be competitive businesses in today's environment [33].

In 2008, FUPPUE carried out a study in some communities of high and very high marginalization and found that in some of them, such as Quetzotla, Chiautla de Tapia, the average family income was 4.5 dollars per day, 62 per cent of household income is spent on food, more than 30 percent of young people migrate to the USA because the lack of employment, 61 percent of adult population and 12 percent of children were obese, 21 percent of children suffered malnutrition. Starting this scenario, FUPPUE designed a productive project called "ranch eggs" aiming young people between 12 and 18 years old considering their wants and necessities. The main objectives of this project were to support poor families in covering their nutritional deficiencies and create conditions for social and economic welfare.

FUPPUE has acted like an intermediary organization in articulating the academic capabilities with real or incipient needs of young farmers, at the same time, this organization

has trying to link the entrepreneurial capabilities of young farmers with market needs. This organization has solved certain problems in the short-term and it has generated potential positive externalities for the long-term. On the one hand, it has improving nutritional circumstances of children and their families, encouraging self-consumption, and creating conditions for social and economic welfare. The families began to consume eggs again with a very low cost, and selling the surplus at good price. This income can be allocated towards other products or services such as food of better quality, education, healthcare, and so on. Organic stores, "alternative markets", supermarkets, and so on, have been interested in the organic product.

On the other hand, the project has allowed the creation of empowerment of children with its farmers, the creation of social capital, attachment to their community, recovering of agricultural activities, and coming back to the agricultural activities with better structural skills. The entrepreneurial capabilities developed in the project are actually an early training model with effects in improving families' nutrition in the short term, however, the long-term effects are still uncertain.

Table 3a and 3b summarizes the characteristics of the cases to be explored as part of an innovation process for inclusive development. The analysis is focused at the micro-level but a good design of federal and state public policies are crucial to fulfill the best conditions for social inclusion. Also university policies and programs can address some of the main problems and challenges in these cases. However these levels are not considered on the document. The empirical cases let to make some additions to previous proposals [1], particularly because health issues are difficult to solve with a more inclusive participation of the community. The cases are in different stages and they have had diverse repercussion to solve social problems. Even though, the four cases show the innovation cycle for inclusive development and crucial factors that must be figured out in order to secure more successful projects.

The cases described have a specific problem or a demand from different sectors. The orphan drug program goal is to attend diseases that involves marginalized populations or diseases that affect just small groups. Pharmaceutical firms do not have interest to fulfill this kind of demands because do not produce huge economic benefits. The artificial heart is a device that has lowered the cost respect to the global market. This fact will permit the use of the artificial heart on public hospitals to attend poor population at developing countries. The TM project goal is to bring medical attention to marginalized and rural Mexican communities. The problems of obesity, malnutrition and lost of identity in rural communities are addressed by the "ranch eggs" project in local farms.

The second phase of the cycle of innovation for inclusive development specifies that to be an inclusive innovation process [1], the affected population has to do explicit the demand. However, we have observed, and the cases describe it, that in health problems is not necessary or possible that the population affected realizes about the opportunities and strategies to solve the problem. These cases show how different actors and organizations are involved to attend and identify the problems: (i) a private firm in artificial heart case, university researchers at the orphan drug program, a

NGO supporting to local farms eggs, and state coordinators of the TM project. We have a diverse set of actors with the knowledge to identify specific health problems. They are the experts, they can do the diagnosis and offer a solution (in some cases with the community or just to attend this population). Health sector requires high-qualified professionals to diagnose and solve the problems.

The third phase is centered over the research or training processes. We identify, in this stage, the participation of university researchers in orphan drug program. The participants at the artificial heart are: university researchers (from inside and abroad), PRC and public hospitals. The participants in the production of organic eggs are basically people from the community, from the FUPPUE, and from the PRC, and physicians from the public health sector at the TM project.

The fourth stage, scaling and prototype production, the main actors are: university researchers, physicians from High-Specialty Hospitals and the enterprise (artificial heart). University researchers and physicians from a Specialty Hospital conduct the orphan drug program production-scaling step. The actors involved at the scaling stage at local farm eggs are larger retail chains in charge of selling and distribution of eggs. Finally, physicians orient the TM project scaling to expand patients' attention. This is achieved multiplying long distance attention areas.

The fifth step, the solution phase, is different in each case. The four cases have some success factors but they are not institutionalized or consolidated, because in some projects everything depends on relational capital and participation. Public High-Specialty Hospital was the first one to use the prototype in a surgery in 2012. Nowadays, the project is looking for extended manufacturing and distribution. TM project has been quite successful but until now it is not enough to arrive to all the people from rural and indigenous localities. Some problems have been found in this case: The lack of experience on the protocols management and organizational design for patients' attention. The "ranch eggs" project has solved important diet and malnutrition problems. Also, the project has strengthened identity and it has been built an entrepreneurial culture between younger people. However, the main problem in this step is the production scaling to attend a growing demand from larger retail chains.

The cases introduce interesting experiences that could be seen as a process of innovation for inclusive development. The cases describe the integration of networks. Learning and social capital construction are key factors on the cases success. Innovation for inclusive development is defined through the cases: innovation, adaptation, diffusion, training processes oriented to fulfill requirements for marginalized population. Health sector requires an intensive knowledge and high expertise professionals that regular people cannot diagnose. Even though, we believe the cases show the inclusivity concern in terms of the kind of problems attended and the target population, and the results obtained. The "ranch eggs" project presents a more inclusive participation from the population affected; in the TM project the population participates just on the final step, the solution

implementation; it could not have been in diagnosis and training because the lack of specialized knowledge.

TABLE 3a. CYCLE OF INNOVATION FOR SOCIAL DEVELOPMENT

| Stages | Activities/Actors | Processes of the cycle | Orphan Drugs Program | Artificial hearth |
|---|--|---|---|---|
| A social inclusion problem is identified (SoIP) | Problem acknowledged by affected population Actors: Affected population | Researchers identify the problem and it is included over the academic agenda when some solutions and a potential demand is identified. | Diseases are diagnosed and demand could come from professional, not necessary the affected population. | The device will be accessible for low cost markets, including public hospital. |
| It is demanded a solution for the problem | Problem has voice or it is visible. Population demands a solution. Actors: affected population, actors linked to the problem NGOs, and government. | Research and diagnosis is elaborated over the problem detected and in contact with integration actors. | Demand could be real or potential. Professionals could lead this demand. Physicians are linked to the problem but are not affected by it. Researchers establish commitments with the director of the Institute of Dermatology. | <i>The enterprise requires to the researcher the device development.</i> |
| It is developed the research over the selected problem | Researchers are involved with demand in a direct dialog with affected population. Actors: Researchers, policy makers, NGO, mass media. | | The analysis of chemical components (thalidomide) and their different uses for diseases that affect very-marginalized population (leprosy). | The research development is followed in parallel with technological supervision and competitive intelligence, design, etc. A company is created to obtain financial support from diverse sources and to integrate participants. |
| It is developed the prototype or the scaling of the product, process or service | The solution is scaled and people look for government intervention and support to solve it. Actors: Researchers, producers of good and services, government. | Public university and PRC can lead the scaling in phases in cases where there is a low interest from private companies to produce goods and services. | University has a more proactive role articulating actors and defining support programs. Researchers with the support of Health Institutes take the drug to the clinical testing. University is also responsible for product scaling. | Researcher develops the prototype and scaled it with support from university, health institutes, and public and private financing. |

| | | | | |
|--|--|--|--|---|
| It is defined an effective solution to the problem | The technical solution emerges and begins the diffusion and adaptation process toward population requirements and characteristics. Actors: producers of goods and services, government and NGOs. | University, health institutes, PRC and government lead solution diffusion and adoption by the target population. | University becomes an intermediary actor. University manufactures low quantities of the drug and gives it to the Institute of Dermatology. | The first surgery using the artificial hearth was in 2012 at highly-specialty public hospital Siglo XXI. Its cost is one tenth of its global market cost. |
|--|--|--|--|---|

The gray shadow remarks the differences between the empirical cases and the (1) proposal.

TABLE 3b. CYCLE OF INNOVATION FOR SOCIAL DEVELOPMENT

| Stages | Activities/Actors | Telemedicine | Local farmers eggs |
|---|--|---|--|
| A social inclusion problem is identified (SoIP) | Problem acknowledge by affected population Actors: Affected population | Government explicit the lack of access of poor population to health care (secondary and tertiary attention). | FUPUED diagnose malnutrition, obesity and lack of community integration. |
| It is demanded a solution for the problem | Problem has voice or it is visible. Population demands a solution. Actors: affected population, actors linked to the problem NGOs, and government. | State coordinators are the way to identify demands and health issues from disfavored people in rural areas. | FUPUE with population affected design the program to solve their problems: local farmers eggs. |
| It is developed the research over the selected problem | Researchers are involved with demand in a direct dialog with affected population. Actors: Researchers, policy makers, NGO, mass media. | State coordinators develop TM project in relation to their technological integration capabilities. The project requires involvement of high-specialty hospitals, technicians and some supply companies. | Technicians, researchers from PRC with training about in situ farming activities lead the second part of the project. |
| It is developed the prototype or the scaling of the product, process or service | The solution is scaled and people look for government intervention and support to solve it. Actors: Researchers, producers of good and services, government. | The health attention structure has a direction center and medical units linked to this center. The center coordinates medical consult between high-specialty hospitals and medical units located along the state. | Young producers face the scaling problem in order to attend longer retailer chains demand. |
| It is defined an effective solution to the problem | The technical solution emerges and begins the diffusion and adaptation process toward population requirements and characteristics. Actors: producers of goods and services, government and NGOs. | TM coordinators face scaling problems. The numbers of units are insufficient for the extent of the health problems. There is a lack of financial support, and organizational design problems to support different activities of TM. | The project had a family coverage until 2012. Diet, obesity and malnutrition problems are addressed, and the activities help to rebuild family and community ties. |

The gray shadow remarks the differences between the empirical cases and the (1) proposal.

VI. CONCLUSIONS

In this paper, a discussion about the proposals that are incorporated in the agenda of innovation studies was presented: innovation for inclusive development that solves demands from disfavored populations along the world. The constant innovation generated in developed countries has been of poor benefit to the population of those countries. In many cases, the innovations are poorly spread to developing countries and when they are, it is at a high cost or many times they are unrelated to local problems. The debate on the different conceptualizations on innovation for inclusive development is the frame for a proposal for its empirical analysis.

This proposal takes three aspects identified on the discussion. First, education and interactive learning are mechanisms to generate social capital due to an interchange of knowledge and better distribution of social benefits [15]. Second, the centrality of actors that in traditional innovation processes had less relevance, such as intermediate organizations, the population that introduces a demand for a solution to a specific problem, the universities and NGOs. And third, a more flexible innovation method that departs from the creation of new knowledge and a new intentionality of the already created knowledge, its adaptation, learning processes that have to be unleashed, imitation as part of innovation and dissemination as fundamental tools for the appropriation that development generates.

One of the central debates that emerge from the actual discussion on innovation for inclusive development takes on the level of participation of the disadvantaged population on different communities and regions in different developing countries. How much can they be involved? Nowadays, some scholars have paid attention to understanding the different levels of inclusion. For instance, some authors identify six levels of inclusion [18]: intention (if innovation is addressed to their needs, desires or problems), consumption (if innovation is adopted and used by them), impact (if innovation has positive impacts on livelihoods), process (if the population is incorporated into the innovation process), structure (if innovation is created within an inclusive structure), and post-structure (if innovation is created within a structure of knowledge and inclusive discourse). Does the methodology require the participation of these sectors in the identification of relevant problems? Or is it possible for these kinds of health problems to be recognized and diagnosed by different actors? Within the medical field it is very hard for the population to participate in the processes and solutions they face. The identification of problems and their solution lies with the experts (doctors and researchers) or with intermediary organizations.

How to build trust departing from collective learning in a highly informal context, cultural diversity, and corruption and weak public institutions? The role of intermediate organizations is fundamental to build bridges between the populations that suffer a particular problem and the actors that are solving it. Also they are key to enabling common language and to built the interoperability of different logics and dynamics. The role of these organizations is fundamental to orientate the efforts of innovation and development of knowledge towards these sectors of the population.

The analysis and methodology of innovation for inclusive development requires the incorporation of institutionalism perspectives to identify the focal points that at macro-level could be managed from a public policy standpoint. Trust, a fundamental factor in the development of links for inclusive innovation, requires learning processes being generated at different levels. In this task, the institutionalism proposals will allow to identify the breaking points in the process of innovation for inclusive development. This is a pending task.

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