

## Innovation for Inclusive Development in Health Sector: Mexican Experiences

Claudia Díaz Pérez, José Luis Sampedro Hernández  
Universidad Autonoma Metropolitana-Cuajimalpa, Santa Fé, México

**Abstract**--Inequality and wealth distribution have been widely researched but not in the field of innovation studies. Recent trends in innovation studies have pinpointed the necessity to strengthen research programs about innovation for disfavored populations over the world. Two main orientations have been identified: (i) Innovation requires the involvement of the people affected in demand definition, as well as solving 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 Mexican innovation experiences for inclusive development in the health sector. The role of intermediate organizations becomes very relevant: universities and public research centers, nongovernmental organizations, associations and local governments are all fundamental to achieve innovation efforts and develop knowledge to solve health demands in 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.

### 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, social capital, and the participation of different actors, such as people that have social or health problems and demand solutions, non governmental organizations (NGOs), intermediary organizations, higher education institutes (HEI) and public research centers (PRC), as well as different levels of government. This paper considers two research questions: First, what are the stages of development of innovations aimed at inclusive development and how are these phases built up from the collaborative learning and involvement of different actors? Second, how do different experiences of innovation in the 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?

Evolutionary economics has established the study of innovation as mainstream in recent decades [29] [30] [7] [23] [24]. From this perspective, one of the principal theses is that technological change and innovation generate industrial development, economic growth, and sustainable development. This is valid for developed countries and, also the relation between innovation and economic growth is not always positive in the time [34]. Countries that are relatively

more rich (Europe, United States, Japan) are relatively more innovative [4].

However, for developing countries, the effects of innovation on development and growth are different. In these countries, a great percentage of people suffer from high levels of poverty, marginalization, and inequality, which would be considered forms of social and economical exclusion. These effects have been analyzed from unorthodox theoretical frameworks (apart from the orthodox); several authors, such as [39], [32], [27], [28], and others, have tried to explain the processes of these effects and propose alternative models of growth and development with a better distribution of income and social welfare.

After this introduction, in the first section we discuss the conceptualization of innovation for inclusive development. We explore the concepts of collaborative learning and social capital, and the role of intermediary organizations as central analytical categories in order to analyze the process of innovation for inclusive development. The next section describes the research design and methods. In the fourth section (results) we present and analyze the cases. Finally, the discussion and conclusions are presented.

### II. LITERATURE REVIEW

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 a firm. Innovation supposes the creation of new technological knowledge and therefore the design and development of those outputs traditionally based on research and development (R&D) activities in the context of maximizing economic benefits. In an aggregate way, innovation should influence the competitiveness and productivity of firms, regions, and economic growth. Reference [4] argued that today's richer countries (Western Europe, United States) are relatively more innovative. Although this correlation has been tested at various points in time, there are other deep causal elements (social, political, cultural, economic, environmental) underlying the processes of innovation and regional development and growth.

In this context, we wonder if the concept of innovation correctly captures the processes occurring in firms and other organizations in relatively less innovative countries, for example, Latin American countries. It is often questioned whether the firm is the only agent of change in these processes of innovation, whether innovation is predominantly based on R&D, whether the market is the sole determinant mechanism, and whether the schemes of private appropriation are compatible with collective appropriation. We also wonder

if other organizations such as NGOs, government agencies, communities, or groups generate innovations, or whether a product, process or service (new or improved) that do not pass through the mechanism of the market is an innovation (for instance, drugs, medical processes, agricultural techniques, improved seeds, and so on, developed by HEI, PRC, or hospitals, and not by a firm). In addition, there are a variety of questions, and little evidence documented, on how to characterize the innovation processes in groups, communities, and organizations other than firms; which would allow 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.

#### *A. Innovation for Inclusive Development*

Inclusive innovation is defined in several ways but it needs a wide debate about the concept and an analytical homogeneous framework. It has been identified a paradigm shift since the Information and Communication Technologies (ICTs) introduction in the economy and society [31]. ICTs have changed the conditions where innovation happens improving employment opportunities, wealth creation, and eventually advancing the quality of life. This paradigm has included the study of innovation for and by the poor and the weak. Some scholars that study this phenomenon coincide that there is an unsatisfactory conceptualization of innovation for inclusive development. The concept has been defined as innovation for inclusive development [4] [15] innovation oriented to social inclusion [17], [1], [2], inclusive innovation [13], [11], [12], inclusive development [39], innovation for inclusive growth [13], socially responsible innovation, innovation for wellbeing [25], socially constructive innovation [24], and innovation for the bottom of the income pyramid (BoP) [32]. These scholars coincide that this concept implies designing and developing products and services aimed to solve problems of poor populations, but also, in some approaches, the key point is the involvement of the affected population with the problem recognition and solution.

Although there are a wide variety of concepts, there is a significant agreement of purpose. One starting definition relevant to this paper is from reference [13], who conceptualized inclusive innovation as the development and implementation of new ideas to create opportunities that raise the social and economic welfare of a population deprived of their rights. This population is at the base of the pyramid [32], or in poverty. These authors believe that inclusive innovation can be a process and at the same time a result. This implies a cyclic causality, because it can be the means to achieve other stages of development and, an increase in the levels of welfare and quality of life and not only better levels of income and employment. Also, it can be the result of other elements such as the development of institutions and policies. In any case, the authors refer to different sub-processes such as learning, coordination and collaboration, and accumulation of capabilities, among others.

Reference [11] highlighted four aspects that shape inclusiveness: 1) The goals of innovation need to have their 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, and; 4) Such innovation must have 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 creation or adaptation of knowledge? If knowledge is a task performed by experts, to what extent does this condition make this a highly restrictive concept? In the traditional field of innovation, the experts are in charge of the development of new knowledge, patents, and, hopefully, innovations in the market.

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

There are a variety of proposals that have allowed conceptualization and, in some cases, empirically address the analysis of innovation for inclusive development. Even in considering the differences among these proposals, there is a common concern about the inclusion of the poor population in receiving the benefits of innovation. Reference [13] equated inclusive innovation with innovation for inclusive growth. Their approach highlight government participation through public policy design and the removal of structural barriers to foster inclusion. Reference [4] and [15] also addressed the understanding of institutional arrangements and public policies to achieve inclusive development or social inclusion. Reference [11] highlighted 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 [18], or people with social problems or disfavoured populations that recognize a demand to be fulfilled by an innovation process [1]. The approaches to the study of inclusive innovation include 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, disfavoured groups, and so on).

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 both market and non-market organizations. This kind of innovation connects 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 governance structures and governed by *uses and customs*) 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 design and development of products and services adapted to the contextual needs of certain populations, groups, organizations, or regions.

Our definition requires a complementary analytical framework at a 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 [41]. This author refers to social innovation as a combination of 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 a rate of return on an investment in innovation.

### A Basis for Understanding Inclusive Innovation

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

#### B. Collaborative Learning and Social Capital

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

Reference [4] and [15] 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. 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, that in these countries there is a better distribution of benefits due to the construction of social capital [4]. The problem is the weakness of the processes of diffusion and socialization of

knowledge toward poor countries. In this sense, inclusive development is explained through globally integrated learning processes, in contexts of social and institutional interactions that govern the behavior of individuals and organizations. For reference [4], [15] and others, learning can be understood as social capital. However, this literature highlights as key factors to develop social capital: trust, reputation, and reciprocal action. In this process collective action and benefits are constructed.

For reference [15] inclusive innovation involved a systemic view of innovation, collective learning, and social capital. This learning is a kind of social capital because it requires a level of trust among actors who exchange knowledge, and in order to implement successful innovation processes it is necessary to have a certain level of social and economic cohesion. In that sense, social capital depends on connections and relationships between people and organizations that emerge from networks and institutions, which in turn fosters learning and collaborative innovation [4]. Likewise, it has been argued that organizational learning requires a level of institutional trust, as in [15].

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) in 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 conjunction with other cumuli of knowledge, transform the behavior of working groups and organizations. Furthermore, from this analytical perspective, institutional learning is crucial in those processes. Institutional learning is defined as the acquisition of skills and knowledge to manage and implement institutional change, and its results are cumulative but uncertain. The basic norms, rules, conventions, habits, and values of society underly in those processes, such that learning is generated at an individual, group, organizational, regional, or national level.

#### C. 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, NGOs, among others. However, the explicit participation of certain actors depends on the innovation models promoted.

How could actors with a lack of resources be included in the innovation process? And how could they be beneficiaries of the effects of innovation? This depends on the model of innovation. In the linear model of innovation the diffusion process is unidirectional, the actors are receivers of innovations and reactive to the generation of products. A second model considers innovation as an interactive process,

in which users or other agents are important in the innovation process [40]. The diffusion process can be unidirectional and users can be pro-active agents. A third model is based on networks of collaboration, in which organizations such as HEI, PRC, users, government agencies, and investors participate in the processes. In this model innovation arises from the interaction of different knowledge sources, internal and external to the organization, and there is a complementarity of skills and knowledge [8], [6].

Reference [10] argue that there are two channels to foster inclusive innovation: 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 the poor population. The second implies participatory exercises among actors in the design and development of products, processes, and services. The first of these two ways of innovation is fairly common and has been documented in several moments. The second is less common and its complexity is greater. The demand-driven innovation implies knowing all the microeconomic variables which are difficult to detect with conventional market studies.

Innovation for inclusive development requires the development of innovative models involving different actors that traditionally were not integrated. A significant role is played by those identified as “transformers actors”, which play the role of interfacing between the neediest people and the organizations responsible for the production and distribution of products. Intermediary organizations facilitate the linkages between the main actors in an innovative network; they contribute to decrease the 'information gaps', and to facilitate cooperation among stakeholders by providing

information on the benefits that each actor can offer to overcome 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 are institutional entrepreneurs [20] [21].

While this analysis emphasizes the role of intermediary organizations, which may be different types of actors (NGOs, 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.

#### D. Cycle to Analyze Innovation for Inclusive Development

The study of innovation for inclusive development presents conceptual, methodological and empirical challenges. 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 characterizing inclusive innovation as incremental innovation, through which it is possible to solve problems of disadvantaged groups. Reference [1] proposed an overview of the whole cycle of problem-identification-research-effective solution in five phases. This cycle is shown in Table 1. In the first two columns the proposals by the authors are shown, in the third column critical proposals to expand the scope of the model are included, in the fourth column other relevant stakeholders are included for each one of the phases identified according to the points made in this article. These authors reiterate that this cycle is not linear; it could have cuts (short-circuits) and flow backward.

TABLE 1. 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. <b>Actors:</b> 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. <b>Actors:</b> 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 and 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. <b>Actors:</b> others researchers, policy makers, organization of civil society, mass media.	Complex problems and its solutions in the health sector could be exhibited and claimed by specialists or intermediaries, and not just by the people affected.	Hospitals, researchers, government, physicians of first level of attention, HEI, PRC.
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. <b>Actors:</b> 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. <b>Actors:</b> producers, government, NGO.	HEI or PRC as intermediary organization.	Nurses, physicians of first level of attention, mass media.

Source: Own elaboration starting from [1].

Reference [1] argues that the problem of social inclusion becomes such when it has a voice, that is to say, when the problem is expressed and received by a particular audience. This means that the problem is connected with the objectives of the people. This allows them to join the efforts of different actors, which 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, and so on. Therefore, in this proposal we consider that a better term is 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 less developed countries. Research can be original, of cutting edge, or imitative and adaptive. In the same way the innovation of products, processes or services can be incremental, but the main characteristic that we seek is that the innovation solves problems that affect disadvantaged sectors of the population. For that it is necessary to make the linkages between research, innovation, and the purpose of this innovation explicit in order to solve social problems, beyond economic growth. The flexibility of the model is central to understanding inclusive innovation diversity patterns.

### III. METHODOLOGY

Multiple-exploratory case studies were used as a research strategy. 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, and data file and documentation. The research strategy allows us to contrast data for similarities or differences.

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

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 is to say, induction and sensitive interpretation were used to establish the meaning of obtained observation and information [22].

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 broaden 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.

### IV. RESULTS

The cases show the solutions development processes through identification of local problems that affect disfavored populations. In some of the cases, the affected population participates in some part of the cycle of problem solution (eggs against obesity). In other cases the role of intermediary organizations, which have the expertise knowledge to identify complex health problems (like in telemedicine), were more relevant. 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 the poor population, or as they call it, diseases of poverty. Multinational companies are not interested in making drugs for markets where the economic benefit is very low. The cases explore the relevance of activities, programs, and attention policies assembled through collaboration with HEI, PRCs or intermediary organizations (NGOs, small companies, and so on), but also with local and state governments.

#### A. Case I. The Orphan Drug Program

The origin of this program is found at one public university. The researchers are interested in attending to the problems of marginalized people in Mexico. Through the links created with hospitals and public health institutions, they have built a bridge between knowledge development, drug production, and patient care. The university program is opened in the mid eighties under the name "Technological development for elaboration and purification of orphan drugs and excipients from diverse backgrounds." This program has the goal of attending to the health problems of poor Mexican populations in marginalized regions, and also the health problems with low incidence rates, or diseases in which multinational pharmaceutical companies are not interested because of the low economic return [33]. The group has been working on finding new uses for old and expired-patent pharmaceutical principles, such as Thalidomine and its use for leprosy.

In the early eighties a group of researchers began the exploration of diverse drugs. They obtained some patents and strengthened their knowledge of health problems that affect marginalized people. The group worked initially with low cost chemical components or drugs with expired patents. Their selections were influenced by the economic restrictions

for university research in their field. Autonomous research and capabilities development led the group to find new applications for patent free drugs.

This program has evolved and been enriched by the integration of researchers and doctors from organizations linked directly to health care (hospitals, public health institutes, clinics, and so on). The group is still working on drugs for unusual diseases that appear in poor and marginalized communities in the country [26]. With low cost research and the correct links, it is possible to attend to problems like leprus. In Mexico, some diseases are associated with socio-economic conditions. This perspective could be very useful, particularly if these kind of programs have public support from universities and local and state governments. The application of Thalidomine to attend leprus in Sonora and Sinaloa patients (in marginalized localities with high temperatures) happened through relations developed between the Metropolitan Autonomous University (UAM-X) and the Dermatological Center Ladislao de la Pascua, in Mexico City. Through this research program, the Thalidomine is synthesized and manufactured. The group uses a small reactor to produce the drug to satisfy the demands of the affected population. When the director of the dermatological center was replaced, the developed link disappeared. The new authorities are not interested in continuing the collaboration [26].

This case exemplifies how innovation for inclusive development began with the abilities created at the university. The research group strengthened a supply of knowledge, but also, because of their research area, they wanted to use that knowledge. The researchers interest led them to look for collaboration with health institutions in order to solve particular problems. They 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 these kinds of programs is limited to the individuals' participation. This case of innovation for inclusive development shows that under the lineal model of knowledge production, and with universities being the process 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 from public policies and programs at the health institutions.

#### B. 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. Over time, a well-known researcher in a Mexican public university had developed enormous ability and knowledge 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 was also looking to diminish the prices, because market prices were out of reach

for regular markets. A market request was presented to the university team. The final product was a medical device with a cost of five thousand dollars instead of fifty thousand dollars. The first surgery to implant this device was completed in 2012 at the public hospital *Siglo XXI*.

Research and technological development to produce medical devices is extremely expensive. University budgets for research and public research programs are not enough to economically support this field, so the traditional research model, where research is sponsored by the government, is not possible. The heart device required the integration of a research consortium with public-private financial participation principally but not exclusively (the Ministry of Economy, the Science and Technology National Council, and a company called Vitalmex). The R&D process that included: research, design, building, testing and sanitary validation required more than 100 million pesos over a period of 10 years [3]. Innovamedica was a company created to link different actors and to manage the research process and economic resources. This company was opened in 2000. The enterprise performed the activities of an intermediate organization. It was a vehicle to link companies in biomedical industries, but also articulated relations with different HEI, PRC and the government. It was the way to make the process more efficient. The new company obtained venture capital in exchange for its future royalties derived from its patent portfolio, and benefits from research services and consulting [35]. It was a *start-up* cultivated at the university, but it could not be opened with university participation because of regulatory restrictions. Innovamedica worked for 10 years, was granted with 25 patents, offered postgraduate scholarships, and had almost 50 highly qualified employees.

This case shows how extended collaboration networks must be in order to produce an invention with a decisive potential to solve main public health problems. The cost of the artificial heart in the global market is so expensive and inaccessible that it overwhelms the public health system. Innovamedica acted as an intermediate organization to articulate financial fluxes. Also it fostered knowledge development, nursed alliances with distributing companies, and established links with public hospitals interested in the invention. In this case, the users of the innovation were very connected since the beginning of the research process. Innovamedica linked public-private contributions and strengthened alliances with multinational companies interested in the invention. However, structural changes at global companies interested in the invention, attempted to appropriate the knowledge and devices produced from the formal contract. As a result, Innovamedica closed and began a legal conflict. Innovamedica's knowledge property was returned, and its relations with Mexican public hospitals were strengthened. The next step was the extended manufacture and commercialization of the product.

This case explored a more complex relationship because of the diversity of the participants. Mexico has a high prevalence of heart diseases. Diabetes and hypertension are

associated conditions. Medical devices have a huge cost, and the prevalence of the problem was one of the motives that inspired an entrepreneur to propose the project. Then, a company identified a market problem (demand) and presented it to a researcher. In the process to support the research, a new company was created. This company, named Innovamedica, was in charge of coordinating a wide set of different public and private organizations (government, S&T council, HEI, PRC, enterprises, and so on). The result was a low cost device, in market terms, which was first used in 2012 in a public hospital. The case explores an intense collaboration cycle, with problems consolidating links in the long term, even though the final result was a successful prototype. Now, they are looking to reach the manufacturing stage and massive diffusion to public and private hospitals. Low cost production and the market price brings this solution closer to the population. This invention was developed at the university with a high potential to solve problems at public hospitals. The disease was present, a solution was developed, and a disfavored population in Mexico will benefit.

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

The Mexican health system has major challenges to face: an aging demographic change which will result in a quarter of the Mexican population being elderly in 2050, and an epidemiological change, which will bring a higher prevalence of non-communicable diseases. For example, in recent years, the prevalence of diabetes mellitus in adults has increased to 14.4%, one of the highest in the world [14]. 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 with around 50% of public hospitals concentrated in 9 states [38]. Although health care reform was completed in 2012, 17.7% of the rural population is not entitled to health services [16].

In order to attend to some of these 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 (the Ministry of Health) has used this technology in southern Mexico (Guerrero, Oaxaca, Chiapas) to attend to poor populations. Telemedicine is composed of hardware, software, and medical peripherals that shape 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, when physical distance is an important dilemma.

Telemedicine works in networks. Each state has one network of telemedicine and four principal agents collaborate: highly specialty hospitals located in urban localities, clinics or rural medical units, patients, and the regional agency of telemedicine (RATM). The last of these is a kind of intermediary organization because it links the health needs of disadvantaged populations with secondary and tertiary health care through TM, and at the same time it

coordinates and manages medical services and integrates medical and ICT.

RATM is the *voice* of the population that needs medical care from secondary and tertiary level health organizations. When patients are sick, they visit a rural medical unit to obtain a diagnosis. If the illness requires attention from a specialist, the patients are linked with a highly specialty hospital through TM. What does this imply? First, people do not need to move from their rural communities to urban localities in order to be diagnosed quickly. If it is necessary, the medical treatment and monitoring can be carried out through TM. 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 the patient, the costs of health care services, transportation, food, and lodging diminish significantly in cases when they need to spend one or more days in the hospital. For the hospital, the cost of operation (diagnosis, treatment, and monitoring) reduces because of less saturation of the hospital. On the whole, this technology helps the patients to obtain timely access to highly specialized medical services and helps the system to expand healthcare coverage.

Third, an important aspect is the dynamic of socialization of experiences between specialist physicians (of the highly specialty hospitals) and general physicians (of the rural medical units). The latter can generate greater capacities in making better decisions in the various activities of medical practice. While the levels of learning in each project have been different, this case shows that in general the practice of telemedicine in Mexico has had positive effects. Certainly, telemedicine allows greater equity in access to specialty services for the rural and poor populations, allows timely diagnosis and treatment, and expands healthcare coverage in rural and indigenous localities.

### D. Case IV. Local farm eggs (Produce Puebla Association)

The Produce Foundation of Puebla (FUPPUE) is a civil society organization managed by farmers, created in 1996 as a not-for-profit association of farmers. Its aims are to promote and facilitate the process of technology transfer from HEI/PRC to farmers, and to develop and finance projects that benefit the rural sector in terms of promoting the integration of small farmers with the productive chains. During its evolution it incorporated other lines of action, such as combating food poverty and malnutrition. It focuses on communities suffering from high and very high marginalization and poverty, 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 [36].

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, and Chiautla de Tapia, the average family income was 4.5 dollars per day, 62% of the average household income was spent on food, more than 30% of young people migrate to the USA because of the lack of employment, 61% of the adult population and 12% of children were obese, and 21% of children suffered malnutrition. Starting with this scenario, FUPPUE designed a productive project called “ranch eggs” aimed at young people between 12 and 18 years old with consideration of their wants and necessities. The main objectives of this project were to support poor families in covering their nutritional deficiencies and to create conditions for social and economic welfare.

FUPPUE has acted as an intermediary organization to articulate academic knowledge with the real or incipient needs of young farmers, and at the same time has tried to link the entrepreneurial capabilities of young farmers with market needs. The project has solved certain problems in the short-term and generated potential positive externalities for the long-term. On the one hand, it has improved the nutritional circumstances of children and their families, encouraged self-consumption, and created conditions for social and economic welfare. The families began to consume eggs again with a very low cost, and sold the surplus at a good price. This income can be allocated towards other products or services, such as better quality food, education, healthcare, and so on. At the state level, organic stores, “alternative markets,” supermarkets, and so on have become interested in the organic product.

On the other hand, the project has allowed for children to become empowered with farmers to create of social capital, to strength their link with their community, to recover agricultural activities, and to improve their structural skills for agricultural activities. The entrepreneurial capabilities development model is actually an early training model with effects on improving families’ nutrition in the short term, although the long-term effects are still uncertain.

The cases are explored as part of an innovation process for inclusive development. Analysis is focused on the micro-level, but 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, although these levels are not considered in this paper. The empirical cases allow us to make some additions to the proposal of [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 repercussions for solving social problems. Even though the cases show the innovation cycle for inclusive development, crucial factors must be figured out in order to develop more successful projects.

Each of the cases described has a specific problem or a demand from different sectors. The goal of the orphan drug

program was to attend to diseases that affect marginalized populations or diseases that only affect small groups. Pharmaceutical companies are not interested in fulfilling these kinds of demands because they do not produce huge economic benefits. The artificial heart is a device that has lowered the cost with respect to the global market, which will permit the use of the artificial heart in public hospitals to attend to markets with low purchasing power. The goal of the TM project was to bring medical attention to marginalized and rural Mexican communities. The local farm eggs project addresses the problems of obesity, malnutrition, and loss of identity in rural communities.

In the second phase of the cycle of innovation for inclusive development, [1] pointed out that to be an inclusive innovation process, the affected population has to explicitly make the demand for a solution. However, we believe, and the cases show, that with health problems is not necessary or possible for the affected population to recognize the opportunities and strategies to solve the problem. These cases show how different actors and organizations can be involved with identifying and solving problems: a private company with an artificial heart, university researchers at the orphan drug program, an NGO with local farm 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, can make the diagnosis, and can offer a solution (in some cases with the community or just to help the population). The health sector requires highly-qualified professionals to diagnose and solve problems.

The third phase is centered on the research or training processes. In this stage, we identify the participation of university researchers in the orphan drug program. The participants in the artificial heart project are: university researchers (from inside and abroad), PRC, and public hospitals. The participants in the local free eggs project in charge of the training are essentially people from PRC, and doctors from the public health sector are the primary participants in the TM project.

In the fourth stage, scaling and prototype production, the main actors are: university researchers, doctors from highly specialized hospitals, and the enterprise (artificial heart). University researchers and doctors from a specialty hospital conduct the orphan drug program production-scaling step. The actors involved at the scaling stage for the local farm eggs project are larger retail chains in charge of selling and distribution. Finally, physicians direct the TM project scaling to expand patient care. This is achieved by multiplying long distance attention areas.

The fifth step, the solution phase, is different in each case. The cases have some success factors even without having been institutionalized or consolidated, because in some projects everything depends on personal relations and participation. A highly specialized public hospital was the first to use the prototype of the artificial heart in a surgery in 2012. Currently, the project is looking to expand manufacturing and distribution. The TM project has been

quite successful, but it has not been enough to arrive to rural and disfavored Mexican population. Some problems have been found in this case, including the lack of experience of the protocols management and organizational design for patients' attention. The local farm eggs project has solved important diet and malnutrition problems, strengthened community identity, and has built an entrepreneurial culture between younger people. However, the main problem in this step is 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, and describe the integration of collaboration networks. Learning and social capital construction are key factors to the success of the cases. Innovation for inclusive development is defined through the cases: innovation, adaptation, diffusion, and training processes designed to fulfill requirements for more disfavored populations. The health sector requires intensive knowledge and high expertise professionals that regular people cannot diagnose. However, we believe that the cases show the inclusivity concern in terms of the kind of problems attended and the target population. The local farmers eggs project presents a more inclusive participation from the population affected, but their participation is on the final step, the solution implementation. It could not have occurred in diagnosis and training because of the lack of specialized knowledge.

Traditional studies of innovation have been mainly focused on enterprise and have a highly specialized knowledge component. Also, the market is the sole determinant mechanism. In this context, innovation can be radical or incremental, can be developed in the laboratory or in-factory through continuous innovation. Additionally, the user of innovation has become a main actor in the process. By the contrary, innovation for inclusive development have a scheme of collective appropriation and not necessarily is market oriented. Additionally, there are other agents in the process: groups, communities, and organizations other than firms. Finally, innovation for inclusive development address problems of marginalized populations.

## V. CONCLUSIONS

In this paper, we presented a discussion about the proposals that are incorporated in the agenda of innovation studies: innovation for inclusive development that solves demands of disfavored populations around the world. The constant innovation generated in developed countries has been of poor benefit to the populations 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 oftentimes 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 in 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 preminent of actors that had less relevance in traditional innovation processes, such as intermediary organizations, the neediest population, the universities, and NGOs. And third, a more flexible innovation method where it is not a condition the creation of new knowledge, but new intentions for the created knowledge. Imitation, adaptation, diffusion, learning processes become essential factors on innovation for inclusive development.

One of the central debates that emerges from the current discussion of innovation for inclusive development questions the level of participation of the disadvantaged populations in different communities and regions in developing countries. How much can they be involved? Recently, some scholars have paid attention to understanding the different levels of inclusion. For instance, [19] identifies six levels of inclusion of this population: intention (if innovation is addressed to their needs, wants, or problems), consumption (if innovation is adopted and used by them), impact (if innovation has positive impacts on their 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 responsibility of identifying problems and their solutions lies with the experts (doctors and researchers) or with intermediary organizations.

How can trust be built with departing from collective learning in a highly informal context, with cultural diversity, and with corrupt and weak public institutions? The role of intermediary organizations is fundamental to build bridges between the populations that suffer from a particular problem and the actors that are solving it, because they enable a common language to be built and the interoperability of different logics and dynamics. The role of these organizations is fundamental to direct 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 institutional perspectives to identify the focal points that, at a macro-level, could be managed from a public policy standpoint. Trust, a fundamental factor in the development of connections for inclusive innovation, requires that learning processes be 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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