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ABSTRACT

Interactive learning is essential for fostering effective innovation processes that contribute to inclusive and sustainable development. The institution at the core of this study is Universidad Mayor de San Simón (UMSS) in Cochabamba, with its Technology Transfer Unit (UTT) serving as the primary promoter and facilitator of SME clusters, which function as interactive learning spaces. These initiatives are inspired by the concept of Developmental University, aimed at producing alternatives for knowledge democratization in the Global South.

Scholars argue in low-income countries the intellectual property rights (IPR) system promoted by the Global North hinders their innovation capacities, not only by restricting access to knowledge, but also by failing to adequately protect their own intellectual assets, including traditional knowledge and biodiversity-related innovations.

One significant challenge in the multi-actor processes of innovation for inclusive and sustainable development is the issue of ownership, which may not initially appear to be the most pressing concern when establishing effective conditions for co-development. What forms of more open and effective intellectual property sharing can support knowledge democratization and inclusive innovation?

In this paper, we present a specific case that allows us to recognize questions and draw insights to explore new IPR alternatives pertinent to environments characterised by developmental university ideals, distributed agency and inclusive innovation approaches in the Global South.

INTRODUCTION

Knowledge-based inequality prevails in the contemporary world (Tilly, 2006). The persistent inability of development initiatives to reduce inequality, despite significant technological advancements, highlights the critical need to explore the complex relationships between knowledge creation, innovation, and development outcomes (Sutz & Tomasini, 2013). It is notable that the assumption that more knowledge and more innovation will always be beneficial, which has been undermined in several fields of social life, particularly regarding environmental issues, is now being questioned in relation to inequality as well (Arocena & Sutz, 2017).

Latin America remains the most unequal region in the world. Reducing inequality requires new science, technology, and innovation strategies that are more directly linked to inclusive development.

> *Inclusive development is a process of structural change which gives voice and power to the concerns and aspirations of otherwise excluded groups. It redistributes the incomes generated in both the formal and informal sectors in favour of these groups, and it allows them to shape the future of society in interaction with other stakeholder groups.* (Johnson & Andersen, 2012)

The normative guide for the discussion presented in this paper is the notion of Sustainable Human Development, based on Sen's (1999) conception, understood as the expansion of people's freedoms and capabilities, emphasising the agency of the least-advantaged sectors.

The geographical context of this paper is low-income countries, more precisely Bolivia, where survival is a pressing concern for far more people than in high-income countries. However, the questions raised and the approaches proposed here remain relevant across diverse contexts, including high-income countries. Multi-actor knowledge production and the imperative of result-sharing transcend geographical boundaries.

In many Latin American countries, the innovation process is often constrained by the promotion of pre-existing solutions without sufficient adaptation to address the specific conditions and needs of end users. The interactions between research and development (R&D) professionals and users appear to be weak. Rodrik (2007) describes this as a weakness in the productive structure.

> *…innovation in the developing world is constrained not on the supply side but in the demand side. That is, it is not the lack of trained scientists and engineers, absence of R&D labs or inadequate protection of intellectual property that restricts the innovations that are needed to restructure low-income economies. Innovation is undercut instead by lack of demand from its potential users in the real economy – the entrepreneurs. And the demand for innovation is low in turn because entrepreneurs perceive new activities to be of low profitability.* (Rodrik, 2007)

If we consider R&D expenditure as a percentage of GDP as an indicator to understand how advanced knowledge is utilised to find solutions, Bolivia demonstrates one of the lowest rates in the region, at 0.06% of GDP in 2021 (VCyT, 2023). Only 6% of R&D

expenditure is attributed to the productive sector, which can be easily linked to the low market demand for advanced knowledge. Conversely, the main research capacities and R&D investment in the country are concentrated in public universities, where international cooperation has played a key role over the past four decades in developing R&D capacities.

Alternative strategies emerging from Latin America recognise that, although market demand is usually low, social demand is high. Thus, the democratisation of (advanced) knowledge is presented as an alternative that focuses on a direct connection between research, innovation, and social demands. Arocena & Sutz (2017) explain that, for this conception, it is assumed that improving – in the social, cultural, and demographic conditions of our time – the quality of life requires, not as a sufficient condition but as a necessary one, the incorporation of advanced scientific and technological knowledge, as well as people with advanced education, into every socially valuable activity.

Under the umbrella of the democratisation of knowledge strategy in pursuit of inclusive development goals, the ideal of a "developmental university" is conceived. As explained by Arocena, Göransson, & Sutz (2015), developmental universities are specifically committed to social inclusion through knowledge and, more generally, to the democratisation of knowledge along three main avenues: democratisation of access to higher education, democratisation of research agendas, and democratisation of knowledge diffusion.

The context of this paper is public university efforts inspired by the developmental university ideal in Bolivia. Specifically, these efforts involve university-led SME innovation clusters functioning as open interactive learning spaces that serve as the overarching framework for co-development. The processes within this framework are conceptualised as Mode 2 knowledge production (Gibbons et al., 1994; Nowotny et al., 2001). The institution at the core of this study is Universidad Mayor de San Simón (UMSS), with its Technology Transfer Unit (UTT) acting as the primary promoter and facilitator of the SME clusters mentioned. UTT's facilitation and training activities are funded by Sida and supported by the Swedish partner team (SICD) at CIRCLE, Lund University, Sweden, as part of a long-term bilateral programme for research capacity building at UMSS.

Since 2007, UTT has been a strategic unit within the Faculty of Science and Technology, established to study and develop alternative, non-linear approaches to innovation. It facilitates open spaces for the democratisation of knowledge and shared capacity building among local SMEs, researchers, and relevant public and private institutions. These efforts have taken shape through the Food SME Cluster and, more recently, the Green Technology SME Cluster—both priority sectors in the development plans of the Cochabamba region. Across the two clusters, approximately 150 firms collaborate with researchers and students to co-develop knowledge-based solutions that respond to their diverse needs. The case presented in this paper arises from the experience gained within the Food SME Cluster.

By integrating interactive learning methodologies into development frameworks, a more nuanced understanding of local contexts and needs can be cultivated. Such alignment not only enhances the relevance of innovative solutions but also fosters

community engagement and ownership, ultimately promoting a more inclusive approach to development.

A significant challenge in these multi-actor innovation processes aimed at knowledge democratisation is the issue of ownership, which may not initially appear to be the most pressing concern when establishing favourable conditions for co-development. Insights from the authors' involvement in cluster development indicate that intellectual property (IP) issues often arise not from direct ownership disputes but rather from branding considerations. A well-developed joint brand can provide considerable advantages for firms within the cluster. However, in the current context of Bolivia, intellectual property rights (IPR) remain poorly institutionalised. Studies by Dosi & Stiglitz (2014) have demonstrated that

> *Intellectual property rights – like other institutions – are social constructions whose objective is to promote the well-being of society. In the case of intellectual property rights, well-designed intellectual property regimes attempt to do this through the expansion and deepening of its knowledge base. But all institutions (including intellectual property rights) need to be adapted to the circumstances, history, and objectives of each country. In many circumstances, intellectual property rights may not be the best way of promoting innovation. Developing countries need to design their own IPR regimes, appropriate to their economies and circumstances* (Dosi & Stiglitz, 2014).

With these considerations, we ask: What forms of more open Intellectual Property (IP) sharing can support knowledge democratisation within interactive learning spaces?

In this paper, we present a specific case that allows us to recognize questions, draw insights and explore new post-IPR alternatives relevant to environments characterised by distributed knowledge production for inclusive innovation purposes. Before presenting the case in detail, the paper outlines the core concepts that inform our theoretical and methodological approaches, followed by a summary of IPR. The paper ends with a discussion of interactive learning spaces for the democratisation of knowledge, and IPR as a commons.

APPROACHES and CORE CONCEPTS

Developmental University

The role of universities in national innovation systems remains a hotly debated topic in Latin American countries, particularly with regard to public universities, where the majority of national research capacities are generally concentrated. Sutz (2012) explained that underdevelopment can be very partially, but not inaccurately, characterised as an ‘innovation as learning’ systemic failure. A systemic failure is defined as the inability of an innovation system to support the creation, absorption, retention, use, and dissemination of economically useful knowledge through interactive learning or in-house R&D investments (Chaminade et al., 2009).

With respect to National Innovation Systems in the Global South, the concept of developmental universities appears to offer a more suitable conceptual framework,

focusing more on socially inclusive knowledge production and inclusive development. Brundenius, Lundvall, & Sutz (2009) explain that the term 'socially inclusive knowledge production' emphasises purposeful action towards producing knowledge, with the explicit aim of solving problems faced by those excluded from common facilities or benefits. This aim can be extended to support production, particularly for SMEs, who find it difficult to purchase ready-made solutions in the world market and may benefit from a more 'tailor-made' approach to their knowledge needs. It is an ongoing concern for civil society that increasing numbers of such problems remain unsolved and unaddressed by both the public and private sectors (Brundenius, 2017).

The relationship between learning processes in general and problem-solving, which characterises the Innovation Systems approach, emerges here as a main orientation for teaching at the tertiary level. Problem-based learning (Gregersen, 2017) is thus a fundamental dimension of teaching in developmentally oriented universities. It contributes to connect teaching with research and extension, even at the undergraduate level (Arocena, Goransson, and Sutz, 2018).

The 'developmental university' has been defined as an open, interactive setting incorporating different groups within society, including industry. However, it does not operate according to the logic of profit-making. Rather, its major aim is to contribute to social and economic development, while at the same time safeguarding a certain degree of autonomy (Brundenius et al., 2009).

As such, the developmental university offers an important and more contextualised framework, particularly relevant for public universities in Bolivia and for stimulating the demanding sector of advanced knowledge. Arocena, Göransson, & Sutz (2015) describe developmental universities as committed specifically to social inclusion through knowledge democratisation along three main avenues:

1. democratization of access to higher education;
2. democratization of research agendas;
3. democratization of knowledge diffusion.

At the same time, the developmental university is characterised by its commitment to inclusive development by means of three interconnected practices (Arocena & Sutz, 2017):

1. teaching;
2. research;
3. fostering the socially valuable use of knowledge.

Democratizing advanced knowledge means then to broaden its scope by taking on board a wide set of research problems and innovation projects that until now have been below its radar. It means putting the might of advanced knowledge – a might nobody would deny, even if fearing its consequences – at the service of people until now underserved by it (Arocena & Sutz, 2017).

Nowotny (2010) highlights, the process of democratization pushes citizens toward becoming involved in the priority-setting of the research agenda therefore in the workings of science as an institution that claims to work for the benefit of society. She

argues for a co-evolutionary process in which science and society become more intertwined. The result is contextualization, as embodying a wide range of changes - economic, cultural, political, and social – through which society "invades" science, but is also "invaded" by science. In its simplest form, Nowotny states, contextualization means that while science has always "spoken" to society, now "society speaks back".

Mode 2 knowledge production

Co-evolving processes in multi-actor settings of knowledge production are crucial where relevance and contexts of application and implication constitute the essential elements. Understanding co-evolution involves an innovation system approach, where interactive learning is the primary mechanism, heavily influenced by specific institutional and socio-economic structures (Lundvall, Vang, Joseph, & Chaminade, 2009).

The main actors in this context include universities (as knowledge institutions), the private sector (industry), and government entities at various levels. In Bolivia, a quadruple helix approach has proven particularly relevant, with the fourth helix comprising 'social society'[1]. This dimension is acknowledged as a significant political actor, fostering a dialogue between scientific knowledge and local knowledge in the development agenda. The significance of this dialogue becomes even more pronounced as policymakers design instruments aligned with the Sustainable Development Goals (SDGs) set by the UN. The SDGs are being commonly understood to promote cluster and innovation platforms that involve societal actors and NGOs within the innovation process. However, while the triple/quadruple helix concepts provide insight into the range of participants, they do not address the underlying mechanisms of *how* the co-evolutionary/quadruple helix process operates. Insights into this 'how' question can be found in research processes referred to as Mode 2.

The background of the Mode 2 concept is rooted in a study initiated and financed by the former Swedish Council for Planning and Coordination of Research (FRN), which led to the publication of "The New Production of Knowledge" (Gibbons et al., 1994). This work provided a comprehensive description of the research process known as Mode 2. Further advancing the discussion, "Re-Thinking Science: Knowledge and the Public in an Age of Uncertainty" (Nowotny et al., 2001) elaborated on these ideas. Mode 2 is characterised by several key features, including its focus on the context of application, transdisciplinarity, a diverse range of sites for knowledge production, high reflexivity, accountability, innovative forms of quality control, socially robust knowledge, and a contextual understanding of implications. The emergence of Mode 2 sparked strong and often hostile reactions from proponents of the dominant university knowledge production paradigm, referred to as Mode 1. This backlash

[1] Bolivia has a very diverse population with more than three dozen native groups, the largest of which is the Quechuas at 2.5 million, followed by the Aymaras (2 million), the Chiquitano (180,000) and the Guarani (125,000). The full Amerindian population is 55%, with 30% mestizo and 15% white. Indigenous people account for 60% of Bolivia's population, including the Andean and Aymaras. Many mestizos in Bolivia assume the mestizo identity while also identifying with indigenous cultures. (cited 190402 at http://worldpopulationreview.com/countries/bolivia-population/).

highlighted how Mode 2 challenges some core tenets of traditional academic discourse.

Advocates of Mode 1 highlight disciplinarity, an internally driven taxonomy of disciplines, neutral and objective research, a context of discovery, the dominance of theoretical or experimental science, and a strict separation between basic and applied research. However, as Gibbons argues, while Mode 2 knowledge production has always existed, Mode 1 represents a highly efficient specialisation of knowledge production that has its origins in the scientific revolution of the 1600s (Merchant, 1980).

Technical transfer

What might an understanding and practice of knowledge production look like in low-income countries? Universities as relatively neutral bodies/platforms in politically diverse contexts, must navigate their strategic positioning to ensure sustainability and relevance. In low-income countries with more or less stable political systems, universities emerge as crucial assets for fostering social, cultural and economic sustainability and development. The universities in these countries face compelling demands for their research outcomes to directly contribute to societal economic growth, often more so than their counterparts in Europe, for example. This means that the 'voice of society' *in* science advocates for the use of very limited public resources in ways that benefit the people as soon as possible, if not immediately. The societal demand for relevant knowledge stems from urgent needs for survival and improved living conditions. Consequently, there is a strong incentive to find other ways than a dominant linear way of disseminating R&D results, which can often be time-consuming and may not always be efficient or contextually relevant. (Trojer 2018).

The growing recognition of non-linear knowledge production processes highlights the need for us to assess the unknown, the unspecified, the uncontrollable, and the irregular in both research and political spheres. What follows for all actors is the recognition that there are inherent limits to knowledge in research. Sheila Jasanoff emphasizes the practice of 'technologies of humility' in favour of 'technologies of hubris' in the dialogue between science and society. Jasanoff (2003, p.225) addresses the driving force behind society's response by asserting that uncertainties and risks are "part of the modern human condition, woven into the very fabric of progress. The problem we urgently face is how to live democratically and at peace with the knowledge that our societies are inevitably 'at risk'".

Technical transfer remains a dominant concept and practice in Western universities. It embodies a linear paradigm where knowledge and technologies are generated at universities and research institutions. These inventions are then transferred to society, either with or without intellectual property rights (IPRs), often contingent upon political approval or legislative demands, before ultimately reaching the end user. The linear paradigm appears to persist as long as traditional, disciplinary (mode 1) universities and predominantly neoliberal[2] economic-political actors dominate. The consequences of this paradigm often include limited relevance to societal needs, inefficiencies, low levels of trust among societal actors, an expanding gap between different societal groups, and a diminished capacity for evolving innovations and innovation systems.

[2] See e.g. Harvey (2005), Davies (2016).

In Sweden, the technical transfer paradigm has often been marked by a lack of context sensitivity and an overreliance on universal solutions. When employing a linear approach to technology transfer from Sweden to low-income countries, such as those in Sub-Saharan Africa, there have been few success stories. These experiences may be one of several reasons why Swedish aid activities have shifted from concrete practices to more abstract policies over the past five decades (Kjellqvist 2013). A technical "transfer" that embraces a non-linear approach, emphasizing co-development between actors in both high- and low-income countries, necessitates "polycentric, interactive, and multi-actor processes for knowledge production" (Jasanoff 2003), including the production of technology.

In Bolivia, the technical transfer paradigm has reached its limits for several reasons. A key factor is the country's weak productive structures, which are characterized by inadequate production levels and insufficient utilization of local knowledge. In this situation, the research capacities of universities to generate relevant knowledge are rarely aligned with local needs. Conversely, more traditional strategies employed by universities to connect research outcomes to development processes (mostly offer-pushed) have not yielded satisfactory results. The successful transfer of scientific results from public research centres to private companies relies on the presence of absorptive capacity within these firms (Martin, 2019). Therefore, enhancing universities' effective participation in inclusive innovation systems and improving firms' absorptive capacity are critical factors for the innovative cluster experiences discussed below.

INTELLECTUAL PROPERTY RIGHTS

In this paper, we focus on inclusive and open innovation processes[3] based on Mode 2 co-creation. Intellectual property rights (IPR) issues are a top priority for open and inclusive innovation, particularly in EU countries. The European IPR Helpdesk provides a Fact Sheet - *Intellectual property management in open innovation*[4] *,* aiming “to highlight the importance of an open innovation model as an opportunity for Small and Medium-sized Enterprises (SMEs) as well as for research and technology organizations (RTOs), and to highlight the issues to be taken into account for a proper management of IP when innovating through open approaches”.

The fact sheet outlines a key understanding of open innovation. Unlike the closed innovation model, where the entire innovative process is conducted internally by companies or universities—often referred to as the "develop it by yourself" paradigm—open innovation presents an alternative approach. In this approach, the development of innovative solutions is based on both internal and external sources of knowledge, fostering collaboration among various R&D actors. This collaboration offers several advantages, such as shortening the time to innovate, reducing costs, and providing access to markets. Another perspective on the open innovation model is to view the innovation process through a challenge-driven lens. This approach typically begins with what are referred to as “wicked problems”. To effectively tackle these challenges,

[3] For us open innovation and inclusive innovation are interlinked. Open innovation processes are based on inclusive approaches.

[4] https://www.iprhelpdesk.eu/Fact-Sheet-IP-Management-in-Open-Innovation

an open innovation approach has proven to be one of the most successful models. Another crucial aspect of open innovation is the “time to market” factor, which emphasizes the importance of being first to deliver solutions rather than having the absolute best product. Achieving this often necessitates a collaborative process involving multiple stakeholders.

Due to the co-development activities inherent in collaborative projects, the allocation of ownership for resulting outcomes is essential for optimal utilization and implementation. Since open innovation is all about knowledge and know-how sharing, the innovation activities within the cluster context should start considering soft forms of IP from the outset of the innovative process. More tangible outcomes from these IP discussions may include memorandum of understanding (MoU) followed by a consortium agreement, joint ownership and the assignment of IP.

In any open and inclusive innovation process, it is essential to develop or adapt various intellectual property (IP) models and approaches based on the specific context and objectives of the cluster actors.

Simon Kremer (2017) writes about *Open Innovation and Intellectual Property – a Troubled Relationship or a Perfect Match?* He states that “it is sometimes suggested that open innovation processes should not be bound by IP considerations in the same way as these more conventional arrangements. For example, there may be concerns that a focus on IP issues will somehow inhibit collaboration and free exchange of ideas within the open innovation model. In some ways, this might even erode trust between the parties. Alternatively, it may simply be assumed that the outcome of the open innovation will be at an early (‘pre-competitive’) stage and that IP can, therefore, be considered later when the research is further developed and applied.....The confidence that comes from knowing that IP considerations have been properly aired right from the start should enhance the trust in the collaboration and facilitate the exchange of ideas. With so many real and practical problems that need to be answered in agriculture, it’s important for open innovation initiatives to focus on ensuring that the best innovative solutions will eventually end up being applied in the real world. Considering IP ahead of the game is one way to ensure innovators do not meet deployment hurdles later down the line.”

There exists a spectrum of IPR for open innovations, ranging from patent on one end to commons-based models, such as open source (e.g., GNU.org) on the other.

As mentioned in the introduction, experiences from Sida-supported cluster development indicate that the IP issues start with a focus on branding. For agriculture/food related clusters, the branding is closely connected to official safety certification, linking the basic sectorial facilities available in the region. The access to analysis lab facilities at universities for certification, specialized training activities and market studies are just a few of the ways, in which cluster firms are starting to cooperate with universities.

Open innovation activities within a cluster context engage multiple partners. The primary knowledge producers in these activities include researchers and the cluster firms involved. In order to foster an inclusive process, the co-production of a desired and identified innovation must be grounded in a mutual understanding, and preferably

an agreement regarding ownership. Valuable assets reside not only within the universities and knowledge institutions involved but also within the specific cluster firms.

IP conditions on the ground in a low-income country are illustrated by the situation in Tanzania (Msuya, Trojer 2018). A comparable situation can be found in Bolivia.

1. Despite the nation's adherence to numerous international conventions and agreements (such as WTO, WIPO, PCT, etc.), awareness of the provisions of these conventions and IP at the grassroots level remains minimal.

2. This lack of knowledge also extends to patents and other forms of IP that are now in the public domain. One aspect is an awareness about the existence of such knowledge, while another is ensuring access to it.

3. Promoting access to technology in clusters establishes an initial platform for shared knowledge of disseminated technologies. While further improvements and innovations on the basic technology are typically retained by individual enterprises, the exchange of ideas tends to be more informal. Each enterprise often safeguards its unique innovations as a competitive advantage, despite the absence of legal protection for any intellectual property.

4. The framework for shared knowledge is not well established, especially with the prevalence of enterprise protectionism.

5. There is no system in place for the registration of industrial designs, which would have been a viable alternative to patent registration.

THE CASE

Open and inclusive innovation processes are evolving dynamics within the cluster contexts, in which we have been involved. The case we present - and from which we wish to draw knowledge democratization insights and intellectual property conclusions - is the Food Cluster emerging in the Bolivian city of Cochabamba. The case is an innovation initiative, focusing on the development of an automated oven for bakery processes[5]. Our methodological approach is Participatory Action Research (PAR) (Reason & Bradbury, 2001). The authors of this paper took part in the case-related processes around in various roles.

Background of the Food Cluster

The Food Cluster Cochabamba is a university space for interactive learning and innovation established by Universidad Mayor de San Simón (UMSS) to foster direct collaboration with the food sector in the Cochabamba region and based on UMSS' research resources and capabilities. SME Clusters developed at UMSS are better understood through the concept of *interactive learning spaces* in Arocena & Sutz (2000). The Food Cluster Cochabamba is a space to create opportunities for problem solving -different types of problems involving advanced knowledge-. These problems

[5] The text of the case can partly be found in Acevedo, Trojer (2018).

are identified by the different actors shaping the cluster, with a special focus on the ones coming from SMEs. The Food Cluster dynamics are inspired by a developmental university ideal, fostering knowledge democratization and interactive learning at the core of its innovation strategy.

In the cluster context, the Technology Transfer Unit (UTT-UMSS) serves as the primary promoter of this university strategy, facilitating the cluster's activities with support from the resources UMSS Innovation Program[6]. According to UTT-UMSS (2015), the number of active cluster members grew from 15 firms in 2008 to 150 firms in 2024. By 2024, some notable characteristics of its members include:

- Size: 80% are micro enterprises (1-9 employees), 15% small enterprises (10-49 employees) and 5% medium-sized enterprises (50-249 employees). All belong to the group of Micro, Small and Medium-sized Enterprises (MSMEs).
- Three associations were also closely linked to the food cluster dynamics - The Chamber of Small Industry and Productive Manufacturing of Cochabamba (CADEPIA), the Association of Milk Producers (APL), and the Eco-Fair Association. Potentially, their members could represent a network of over 2000 small production units. Additionally, the National Service of Agricultural Health and Food Safety (SENASAG) plays a crucial role in the development of the food cluster.

This critical mass of firms is regarded as the core of the cluster, as the majority of activities have concentrated on enhancing the absorptive and learning capacities of the firms, enabling them to act as agents in innovation processes. UTT periodically encourages representatives from government bodies in the food sector and qualified researchers to participate in cluster activities, including individuals from the Vice Ministry of Science and Technology, regional government secretariats, regulatory agencies, university researchers, teachers, and students.

The Innovation Initiative

In the initial phase of this specific case, pre-graduate students played a crucial role. They engaged in undergraduate internships and projects, moving between cluster firms and university research centres. One key finding during this phase was that baking processes were prevalent among the food cluster firms. Additionally, it was noted that the poor quality and inefficiency of their ovens compromised both product quality and production capacity.

The Centre for Food and Natural Products (CAPN) identified several specific demands and possibilities for long-term collaboration within the cluster platform. As a result, the centre assigned one of its new doctoral students to study bakery processes, based on the local production of raw materials, specifically Andean pseudo-cereals, and the relevant industrial capacities[7].

[6] In 2007, the UMSS Innovation Programme was launched at UTT, recognising the relevance of the National Innovation Systems (NIS) approach, with support from Sida. The definition of NIS in developing countries proposed by B.-Å. Lundvall, Vang, Joseph, and Chaminade (2009) was adopted as the theoretical framework. The UMSS Innovation Programme sought to develop institutional competences and capabilities for studying, promoting, and actively engaging in innovation processes at the local, regional, and national levels (UTT, 2006).
[7] See Perez 2019.

The UTT team organized visits for researchers to the food cluster firms to learn about the general characteristics of the ovens. Some observations included:

- Low production capacity of the oven.
- Low standardization in flour combinations used for bakery.
- Non-uniform heat distribution in the oven.
- Inaccurate control devices for variables such as temperature, humidity and time.
- Few safety and alert handling mechanisms particularly in one company, whose operators were blind.

Consequently, ovens and bakery processes were identified as practical and concrete areas for collective work in an innovation project.

How to secure funding for the Innovation Initiative

Once the oven issue was identified and prioritized by the Food Cluster, the UTT team gathered all the relevant information and began designing a project to secure funding. In September 2012, they identified an opportunity in competitive funds launched by ProBolivia, a government development agency supported by European Union resources. This initiative aimed to promote social inclusion, foster innovation and diversify national production.

ProBolivia launched a funding program that offered up to 80% support for innovation projects in strategic sectors, prioritized by regions. While the food sector was prioritized for the Cochabamba region and the bakery sub-sector was not included in the funding program, ProBolivia call was aimed at strengthening honey, chocolate and exotic fruits. In response, the UTT facilitating team proposed an alternative approach by presenting the project in the metal-mechanic sector, which was quickly accepted by the cluster members. The project was approved, with UMSS providing institutional representation, and UTT administration support funded by ProBolivia (80%) and by UMSS (20%). The project was approved with the objective to strengthen the technical capacities of the Program of Manufacturing Technology Development (PDTF) for research and prototyping semi-industrial machinery, while also supporting innovation processes in the Food Cluster Cochabamba.

The project's approval was based on the following components:

- Acquisition of welding equipment and training for PDTF's technicians on semi-industrial-machinery design and building. This equipment complements the existing capacities at PDTF.
- Design of an automated oven based on the needs identified through dialogue between the firms of the Food Cluster Cochabamba and researchers at UMSS. This effort will utilize the Mode 2 - knowledge production and methodological approach as developed by Gibbons et al. (1994) and Nowotny, Scott, & Gibbons (2001).
- After optimizing and validating the design with input from cluster firms and involved researchers, a prototype of the oven will be constructed.
- Installation of the prototype in the pilot plant of the CAPN, for testing and complementing functions, with the existing equipment and services offered to food firms.

- Development of pilot tests for technology transfer to local metal-mechanical industries, facilitating access to the oven design in the local market without restrictions on IP.

There were difficulties to overcome during the execution of European Union funds as heavy administrative structures at both the government and university levels caused by challenging delays. However, experience and institutional efforts positioned UMSS and UTT as a regional benchmark for ProBolivia as key partner for the implementation of other innovation programs in Cochabamba in the development agenda (i.e., sectorial innovation centres, production networks, science parks and specialized training programs).

The Interactive Innovation Learning Process

Who

The innovation project involved three research centres at UMSS, namely the Program of Manufacturing Technology Development (PDTF), the Centre for Food and Natural Products (CAPN), and the Program for electric and electronic engineering (Elektro), which focused on the automation and digital components of the oven.

Not all bakery firms within the food cluster were willing to disclose their bakery processes and business plans, which is understandable given the cluster's values of both cooperation and competition (co-opetion). However, one bakery firm was noticeably open to extensive involvement in the innovation process. Valuable assets for the development of the oven prototype emerged from cooperation with a bakery firm, which primarily focused on work safety issues and smart functionalities. This particular firm employs blind operators.

The PDTF connected two groups of pre-graduate students to establish the technical parameters and create a preliminary design. These students were enrolled in the Design for Industry, Modelling and Simulation course at the School of Industrial Engineering. For this purpose, periodic meetings were organized with firms and researchers from CAPN and PDTF, along with visits to cluster firms.

How

One student in his final semester of the Electro-Mechanic program was hired to exclusively develop the final design and the oven prototype at PDTF. He also integrated this project into his thesis. UTT facilitated an interactive dialogue between this student and a transdisciplinary team of specialists connected to the cluster including:

- 2 Mechanical Engineers from PDTF.
- 2 PhDs and 1 MSc in food technology from CAPN.
- 1 doctoral student in food technology from CAPN and 1 in innovation systems from UTT
- 4 MSMEs of the food cluster specialized in bakery and Andean pseudo-cereals.
- 1 administrator, 2 facilitators and 1 general coordinator from UTT.

The design process and prototyping involved planned periodical technical meetings with researchers, including the PhD students studying the bakery process, as well as following and testing the functions with the cluster firms. These meetings enabled the

designer to integrate science-based and experience-based knowledge, while ensuring the oven met the requirements of the cluster firms. Consequently, an automated oven could be designed according to the needs identified through the dialogue between the firms of the Food Cluster Cochabamba and researchers at UMSS. As mentioned earlier, the methodological approach was grounded in the use of 'Mode 2 - knowledge production', as articulated by Gibbons et al. (1994) and Nowotny, Scott, & Gibbons (2001).

Welding equipment was acquired and PDTF's technicians received training in semi-industrial-machinery design and construction. This equipment complemented the already existing capacities at PDTF.

The construction of a prototype oven with an optimized design was validated by cluster firms and the involved researchers. The prototype was installed at PDTF and was available for firms, researchers and students.

Results

The design process and prototyping resulted in a turbo-forced oven with variable rotation, characterized by the following features:

- Capacity for baking 120 kg of products on trays.
- Utilizes a forced-type burner.
- Equipped with a cooking chamber with a closed-circuit recirculation system.
- Features an adjustable tray rotation system with customizable distances between trays.
- Includes a humidification system (steam) to ensure product quality, texture and appearance.
- Designed for easy assembly with an interior made of stainless steel, and an exterior made of carbon steel treated to prevent corrosion.
- Provides an automated control system for managing temperature, humidity, airflow, time and tray rotation.
- Incorporates safety features and ensures comfortable handling conditions including handling heat isolation, noise, signalling, alarms and a control panel.
- The engine and electronic components were supplied by importers in the local market. The remaining components were manufactured in Bolivia, with all adaptations, part production, and construction carried out at PDTF.

The prototype was made available for testing, serving the cluster firms and researchers at the PDTF plant. To facilitate experimentation and data collection regarding its performance—such as recording temperature curves, humidity levels, airflow, and energy efficiency—precision measuring devices were incorporated. This development aimed to meet the needs of both students and firms.

The relationships established between the food cluster members and the metal-mechanic technicians during the project highlighted the strategic potential of the metal-mechanic sector in the region, extending beyond just the food sector. Thus, UTT initiated efforts to launch a new cluster platform at UMSS, aimed at enhancing the capacities of metal-mechanic firms to locally develop and reproduce technology.

Results – namely, new technologies, procedures, organizations etc. – are classified as innovations once they are IN USE. The oven qualifies as an innovation, when utilized by the cluster firms and the researchers. Additionally, it is considered an innovation when produced by local metal-mechanical industries, enhancing the availability of the oven in the market. In general, most bakery ovens in Bolivia are reconditioned, using parts sourced from Brazil or Argentina, which introduces various challenges. Consequently, the university recognized the importance of creating a similar cluster platform for the metal-mechanic sector. This initiative could serve as a foundational and more coordinated effort for local industrial technology co-production and reproduction.

The story continued

In the subsequent years, the process to foster innovation related to the PDTF continued.

Changes in the directors of the PDTF created challenges for the oven project. The new directors were unfamiliar with the project's objectives, context, and purpose. One of these directors categorized the oven as a physical asset at the PDTF using the same codes as office chairs, making it impossible to replace the oven for use by the cluster firms or food researchers at the UMSS food research centre. As a result, the PDTF ended up disassembling different parts of the oven, leading to a non-functioning device.

However, the story did not end with this setback. The oven project enabled a long-term partnership between the UTT and the PDTF to jointly promote interactive learning and innovation processes within cluster spaces: the Food Cluster and the Green Technologies Cluster. Nowadays, the development of technological innovations in the form of machine prototypes to solve specific SME problems is a core activity demanded in both clusters.

PDTF researchers lead these projects within clusters and, depending on the specific challenge, they are developed in collaboration with researchers from other research centers (e.g., food, energy, bioprocesses, materials, or others), undergraduate students, and representatives of interested SMEs. The development of each innovation project is supported completely by the UTT facilitation team assigned to each cluster. So far, international cooperation for research development in Bolivia has been the main source of funding for the development of technological innovation within the cluster environment, along with SMEs' own funds (about 20% of total costs).

The adoption and adaptation of the Design Thinking methodology meant a qualitative leap forward in strengthening innovation and learning processes within these clustering environments. This methodology takes an interactive, end-user-centered approach to problem-solving, fostering innovation, creativity, and learning among the stakeholders involved. SMEs involved in technological innovation projects also adopted this methodology as part of their business model for innovation within clustering spaces.

In addition, various projects to promote innovation within clusters have successfully attracted funding for the purchase of minor equipment, software and training activities to improve capacities in design, simulation, and prototyping. More recently, all these

efforts were gathered and organized in the form of a lab to strengthen its effective participation in technological innovation processes within clustering spaces.

PDTF and the Prototype Lab
The oven project empirically demonstrated that the PDTF could dedicate efforts, as part of its job assignment, to deliver technical solutions for industrial firms in the form of machines.

This increased self-confidence helped the PDTF thrive. As of December 2024, the PDTF director had been in his position for four years and was eager to engage with UTT both before, during, and after the pandemic in a meaningful way. With a clear vision, he recognized a significant opportunity for the PDTF to reclaim its institutional standing as a centre of relevance, not only within UMSS by enhancing the skills of students working with metal materials, but also for external companies beyond UMSS.

This collaboration with UTT has positioned the PDTF as a valuable resource within the INNOVA project. It has resulted in the establishment of a PDTF laboratory for prototyping, which serves both clusters and researchers. This prototype lab was created to function as a permanent, cost-effective resource, facilitating quicker outreach to firms while also optimizing resource use in terms of time.

The prototype lab serves as a collaborative space for learning and enhancement, building on existing knowledge rather than starting from scratch. So far, it has attracted various resources, notably from Sida, which has provided equipment, materials, prototype development support, and training courses. From ELANET, the lab has secured high-quality computers for heavy simulation software, furniture, advanced scanning machines, and three 3D printing machines (two for students and one for researchers at the PDTF). Additionally, the governmental HC fund has supplied expensive software licenses, and in collaboration with DICyT, further licenses have been arranged for researchers in chemistry and mechanics at UMSS, along with support for prototyping and training. While the administrative procedures took 1.5 years, the outcomes have been immensely beneficial for the production of prototype machines and the training of students using this software. The prototype lab has opened a pivotal avenue for a new research network focused on simulation, positioning the PDTF at the heart of these initiatives.

The open access licence to the prototype drawings remains available. They can be shared as long as UMSS is recognized. This means the drawings can be used freely under open access, but UMSS retains ownership. Any improvements to the drawings must also be shared. It remains to be seen how the open access licenses will work in practice. The key point is that UMSS must be properly acknowledged.

It remains to be seen how other IP alternatives to open-access licences will work in practice in the Bolivian context. The key point is that any IP tools employed must both facilitate the democratisation of knowledge and ensure that UMSS’s contributions are visible to society.
The PDTF will not register the prototypes with codes, as was done for the oven. The issue with the oven was a mistake.

DISCUSSION

Interactive learning spaces for knowledge democratization

In Bolivia, the implementation of policies aimed at strengthening an inclusive innovation system remains largely unrealised (Acevedo, Céspedes, & Zambrana, 2017). Emerging innovation system initiatives, such as the cluster experiences mentioned above, demonstrate increased effectiveness by fostering inter-institutional efforts and production collaboration, starting from the grassroots level.

The adoption of the Developmental University ideal by the Innovation Programme at UMSS reflects a contextualisation of its university strategies to participate in and promote inclusive innovation systems in Bolivia. This represents a direct university approach towards knowledge democratisation, aiming to establish a direct link between its research agenda, innovation processes, and social inclusion, while maintaining a degree of autonomy. Nevertheless, in a context of low effective demand for advanced knowledge in Bolivia, additional efforts were required to attract local productive actors into innovation system dynamics.

UMSS took a proactive role as facilitator in the inclusive innovation process, fostering multi-actor collaboration, trust-building, support in innovation management, and promoting dialogue on equity to create a common agenda. At the same time, the university campus, as the platform for interactive learning spaces (clusters), became an open, problem-solving oriented space, with a long-term perspective for the development of innovation capacities in collaboration with various societal agents. Universities enabling interactive learning spaces serve as a cornerstone for fostering innovation processes and innovation systems that are not only inclusive but also sustainable, facilitating a more effective response to societal challenges.

The Developmental University is an emerging approach being put into practice by several universities in the Global South. There is now a growing body of literature discussing good practices for developmental universities. According to Arocena & Sutz (2017), in general, developmental universities can face four main challenges in practice.

- The first challenge is to establish legitimacy for initiatives that fall outside the university's mainstream activities.
- The second challenge concerns interdisciplinary work. Issues of social inclusion cannot, by definition, be addressed by a single discipline.
- The third challenge is to reform the academic incentives system so that activities such as research—while part of the university's traditional functions but now directed towards non-traditional goals—can be properly evaluated and rewarded.
- The fourth challenge relates to attitudes towards research, and more broadly towards knowledge itself and who is recognised as knowledgeable.

Limited efforts have been made to understand users or to manage technology transfer as an interactive process (Abrol, 2014). Most initiatives in this direction seem to be isolated efforts, while linear models of technology transfer continue to dominate as the prevailing paradigm, despite their proven limitations. Inclusive innovation necessitates a dynamic connection between challenges arising from inequality and agents capable

of fostering and implementing innovative solutions (Couto Soares, Scerri, & Maharajh, 2014).

The integration of interactive learning into the innovation process is not merely advantageous; it is essential for achieving sustainable development outcomes. As we stand at the intersection of technological advancement and social equity, it is vital to adopt strategies that promote collaboration and inclusivity. By prioritising these principles, we can ensure that our development efforts are not only effective but also capable of addressing the systemic inequalities that have long hindered societal progress. The call to action is clear: to rethink and reformulate our approaches to knowledge and innovation in ways that genuinely benefit all members of society (Sutz & Tomasini, 2013).

IPR as a Commons

The case in the form of an open innovation project established pilot tests of technology transfer to local metal-mechanical industries, enabling the availability of the oven design in the local market *without restrictions related to intellectual property* (open IPR).

The project also served as the basis for an undergraduate thesis, highlighting specific implications concerning intellectual property rights (IPRs). According to university regulations, all research and thesis projects become the intellectual property of UMSS, with the aim of serving the public good. In this case, both the tangible assets (the prototype) and the intangible assets (the knowledge generated through collaboration) are collectively produced within the cluster, with the objective of promoting rapid replication, broad accessibility, and the attraction of new collaborators to foster incremental innovation.

All drawings are accessible to any national metal-mechanic firm for reproduction. While the design can be further developed, the original IPR as created at UMSS remains unchanged. The drawings will continue to be available for national firms to use.

The developed oven serving as a *common*[8] was implicitly defined from the outset, reflecting the objectives of joint definition and collective knowledge. The collaborative search for resources for prototyping was conducted under the auspices of the cluster, with institutional support from UMSS (acting as the lead guarantor and resource manager) and the coordinated involvement of university research centres (data definition and usage conditions, prototyping, and other necessary adjustments).

This example illustrates how an innovation emerged as a *common* in a specific context of the Food Cluster in Cochabamba, Bolivia.

The innovation project was developed in a typical mode 2 context, characterized by advanced distributed knowledge processes, involving knowledge producers beyond traditional academic settings. This raises questions about how to approach ownership differently than conventionally understood. Inclusive and open Innovation processes

[8] See above under subchapter IPR concept.

problematize the limitations of IPR settings, as well as how university knowledge co-production can be effectively utilized for development.

Clusters, as sectorial interactive learning spaces, have become an integral part of the official innovation policy, demonstrating satisfactory results as a *developmental university* approach (Brundenius, Lundvall, & Sutz, 2009) in Bolivia. The model is being replicated as a valuable asset in regional innovation systems, where the role of the public university is increasingly recognized in local development processes. These public university platforms play a crucial role in facilitating the long-term collaboration between the quadruple helix actors, thereby enhancing their absorptive and innovative capacities for inclusive and sustainable development. A positive outcome of a situation of IPR settings not yet well institutionalized is that the university can adopt a flexible approach to producing *commons* in the context of the Bolivian clusters. The latter fosters constructive collaborations among the various stakeholders involved. It is important to note that most innovation processes yield highly contextualized solutions, which do not necessarily aim for global applicability.

The risk we can anticipate, if we follow the traditional Global North approach that favours patents as the preferred IPR strategy, is that too many results will remain on academic shelves and fail to address society's needs. Alternatively, research outcomes intended to support local development processes may instead be exploited by better-positioned companies abroad.

In conclusion, we argue that innovation projects involving multi-actor processes lead us towards a post-IPR setting and new models of ownership, where knowledge commons are becoming increasingly relevant.

ABBREVIATIONS

CAPN	Centre for Food and Natural Products
DICyT	Dirección de Investigación Científica y Tecnológica
ELANET	European Latin-American Network in Support of Social Entrepreneurs
IP	Intellectual Property
IPR	Intellectual Property Right
PAR	Participatory Action Research
PDTF	Program of Manufacturing Technology Development
RRI	Responsible Research and Innovation
SICD	Sustainability Innovations in Cooperation for Development
Sida	Swedish International Development Cooperation Agency
UMSS	Universidad Mayor de San Simón
UTT	The Technology Transfer Unit

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