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Article

Open Innovation with Value Co-Creation from University–Industry Collaboration

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Abstract: While open innovation and university–industry collaboration contribute significantly to innovation in industrialized countries, it is less clear how these create value in emerging economies and new application contexts. This study examines the introduction of global practices into the Nicaraguan context. Adopting a service-dominant logic perspective of value co-creation through interaction on multiple levels, we noted the importance of systemic orchestration or staging of the ecosystem, organizations, and challenge project delivery. We also recognize the importance of enabling activities and spaces that promote innovation. While our findings indicated that the expected and perceived value creation did not fully match, we found encouraging signs of the build-up of foundational practices to support national development agendas. There is evidence of shifted mindsets and looped learning across the system. We propose a model for the systemic development of enabling structures, value creation, and innovation spaces when transferring practices into new application areas. We expect this model to be useful for practitioners when planning and engaging in transferring open innovation practices across application contexts. The study contributes to our knowledge and practice of creating value through applying open innovation within university–industry collaboration in emerging economies, a little-studied theme.

Keywords: open innovation; university–industry collaboration; innovation intermediaries; service ecosystems; service logic; co-creation of value

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1. Introduction

Open innovation (OI) is often touted as a universally positive proposition that leads to value creation and positive impacts in multiple contexts. Seen as a key driver of innovation, it emphasizes the flow of resources, knowledge, and practices across organizations and places [1–3]. At the same time, university–industry collaboration (UIC) has become a significant approach to innovation that links students, academia, and firms within collaborative initiatives [4,5]. As such, the idea that one should exploit external resources to innovate appears to be an inherently attractive and valuable endeavor, also within UICs. That said, it is also acknowledged that the outcomes linked to the application of new innovation practices are highly dependent on the context, application approaches, and prevalent conditions [6,7]. A particular concern is related to the application of industrialized country innovation practices in emerging economies with less well-developed industrial bases, markets, and related economic institutions and structures [8].

In this paper, we examine value creation through OI within university–industry collaborations (UICs) [4,9] in Nicaragua, an emerging economy in Central America. More specifically, we ask: What is the perceived value created by introducing global OI practices into a local UIC context with scant or no previous experience in OI, and how could these practices be fostered and transferred to other application contexts? We understand this

practice involves the introduction and diffusion of knowledge, structures, and places that enable purposeful collaborative innovation processes across UIC. We contribute to the understanding of value creation, knowledge flows, and learning loops through OI within UICs in emerging economies, suggesting that attention must be paid to the systemic development of enabling structures, value co-creation, and innovation spaces.

With one of the lowest GDPs per capita in the region, and depending on commodity production and exports, Nicaragua has been investing significantly in digitalization and related infrastructure to reduce poverty and generate economic opportunities by enhancing competitiveness and diversifying exports [10]. Within this agenda, OI has been promoted in the UIC context (seemingly for the very first time in Nicaragua) as a value-creating approach linking industry, academia, and young talent. A network of local innovation hubs has been set up at multiple universities throughout the country, supported by international actors and an externally sourced concessional loan. The initial aim was to engage students and start-ups to develop ICT solutions and entrepreneurship, leveraging the new regional broadband infrastructure. The expected high-level value creation aimed to extend the range of competitive factors through new processes and transfers across application contexts.

As, e.g., Vallejo et al. [8] and Hossain [11] note, the north–south transfer of OI practices and related knowledge resources within UIC is complex and challenging, with scant existing literature to date. Through a case study, this exploratory study examines the perceptions that participating actors have of OI creating value in UICs. The study adopts a multi-level service-dominant logic perspective [12], building on the notion that the incoming global OI practices within UICs would enable local co-value creation through rewriting institutional norms, delivering novel offerings, and reconfiguring processes, while providing new platforms for interaction. Through a series of in-depth interviews and wide engagement in the set-up and delivery processes, we explore the co-staging of systems, co-creating of value, and co-designing of innovation spaces that underpin the future development of wider aims.

Building on Chesbrough [1] and Chesbrough and Bogers [13], we understand OI as an innovation process that is distributed, purposeful, and based on knowledge flows across organizational boundaries and jurisdictions. We furthermore note the focal attention to value creation by Chesbrough, Lettl, and Ritter [14], and to gaining advantage by using external knowledge and ideas in addition to internal ones. Despite wide diffusion in academic writing, both research and implementation issues remain challenging [7,15]. As Tidd [6] notes, it is challenging to derive well-structured knowledge on the structure and processes of OI, and as the practice and implementation remain somewhat unclear, value creation is correspondingly opaque [16]. Applying OI to emerging economy contexts involves challenges in the transfer of unfamiliar approaches and knowledge across application contexts, undeveloped industrial bases and markets, and weaknesses in underlying economic institutions and structures [8,11,17,18]. The outside-in boundary spanning [19] can also be complex due to the capability asymmetries between parties [18,20].

Past UIC has often had a focus on knowledge and technology transfer [4], a core motivation in north–south collaboration. In industrialized contexts, intense competition, exponential growth, and the diffuse nature of knowledge, together with shifting resource bases, have encouraged UIC [21,22], transforming it into a key source of innovation [5]. Student-centric and challenge-based learning have become central to UIC from mid-1990s [23–25], with students increasingly engaged as lead innovators and users [26]. Within UIC, universities act as innovation intermediaries, forging and sustaining collaboration between actors, enabling value creation through capturing and diffusing knowledge and engaging, connecting, and supporting actors [27–29]. Building on the early work on brokerage [30,31], intermediary organizations act as learning hubs, facilitating, configuring, and brokering activities and providing knowledge-intensive innovation services [27,32], enabling the processes of commercialization and engagement [4].

Innovation intermediaries often organize their activities as service ecosystems [33,34] nested within wider entrepreneurial [35,36] and innovation systems [37]. Service ecosys-

tems integrate the resources of universities, entrepreneurs, social innovation actors, the public sector, and students, leading to the co-evolution and co-creation of value [38,39] at the touchpoints between producers and consumers [40,41]. Multi-stakeholder collaborations come together on platforms [42] connecting individuals and organizations [43,44], integrating the service delivery toward users [38,42,45].

In this study, services are understood to form the basis of exchange and value co-creation [38,46] through social interaction, dynamic resource integration, and the production of new resources, regulated by institutional logics [47] and protocols of interchange [38,48]. Services are perishable and intangible, co-produced with clients [49]. Within a service perspective of UIC, OI supports value co-creation in context, in exchange, and in use [14,50]. Value is understood here as the comparative appreciation of reciprocal knowledge or practices that are used, exchanged, or shared in the interaction and for a common purpose, defined ultimately by the beneficiaries [39,51–53]. In OI and UIC, multiple beneficiaries may exist in any single interaction, and co-creation implies creating value for all, applying cumulative experience through direct interaction [54].

Learning activities emerge as a focal concern when diffusing knowledge and transferring OI practices across application contexts. The participating universities and partners engage in organizational learning and related loops [55–57], which are manifested in the changes that the actions undergo and the way of evaluating its results [58–60]. Defensive routines may moderate these cyclical processes and act as barriers to learning, emerging in the non-fulfillment of desirable but exogenous objectives, potentially masked by rationalistic reasoning and justifications [61,62]. The study context is illustrated in Figure 1.

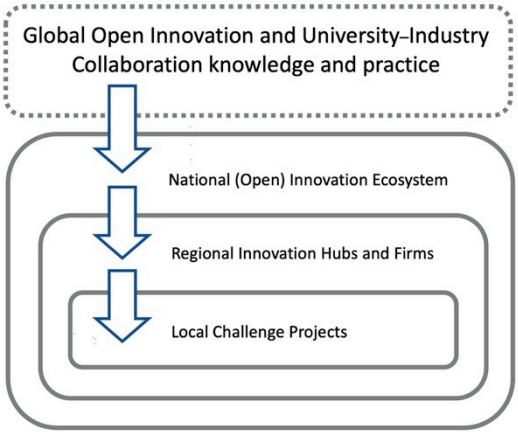


Figure 1. Open Innovation Ecosystem Framework.

2. Materials and Methods

In this study, we examine and aim to understand value creation by introducing global OI practices into a local UIC context—one with little previous experience of OI in UIC. We also explore fostering these practices and theorize as to how they could be transferred to other application contexts. We adopt a single case study approach with multiple embedded units of analysis, suitable for extreme or unique cases [63], to provide a rich, qualitative account of the application of OI into a novel UIC context, while theorizing within the specific case on potential futures [64,65]. We build on documentary sources, the perceptions of interviewed actors, and the direct participatory observation of the researchers, all fluent in Spanish [66]. As we are studying an emerging phenomenon, we adopt an interpretivist position within a qualitative research tradition, noting that absolute truths are elusive in the study context [67,68]. We propose that this initial qualitative and exploratory study is well placed to inform a wider future enquiry based on mixed qualitative and quantitative methods. An initial literature review and a consultation of the project documents enabled identifying the core elements and their relationships in the study (Figure 1), together with the key research questions and the methods to apply [67,68].

Data collection in Spanish was conducted over a three-year period (2018–2021). Multiple secondary sources included public domain project documents and proposals, four detailed results reports, four on-site visit aides-memoires, project management data, communiques, projects memos, and visual evidence. Participant interviews involved three stages. The first interviews included actors involved in project design, development, and launch, selected to understand the scope and context of the project, together with the initial value expectations. Secondly, interviews targeted actors involved in innovation hub operations to understand their expectations and perceptions of value creation. Finally, actors involved in specific open innovation projects were interviewed to understand their perceptions of value creation. Three interviews were conducted in stage one, six in stage two, and four in stage three in 2020–2021. The interviews were managed as informal conversations around semi-structured agendas to produce useful non-biased-question information [66,67]. Participatory observation included a mix of both facilitating and attending ten workshops with two hundred and forty stakeholders, including the leading team, students, professors, entrepreneurs, SMEs leaders, project sponsors, university managers, and innovation hub leaders [68]. These events took place over two years in the cities of Managua and Bluefields, and virtually (because of COVID-19 restrictions) during 2019 (Appendix A).

Data analysis involved systematization and reduction [67,68], processed in two stages, initially through the analysis of project documentation and workshop results to build the case history from 2018 to 2020. This informed the initial research construct in Figure 1. The second stage was based on interviews, observation data, and documentary evidence. This stage of the data analysis used both descriptive analysis and thematic coding by multiple researchers [67,68] to validate individual declarations and observations and to uncover patterns, causal relationships, and incongruities. This stage enabled the sensemaking process of modelling value creation in OI within UIC (Figure 2). To ensure the validity and reliability of the study, triangulation techniques were applied both in the set-up and data analysis [63,67,68].

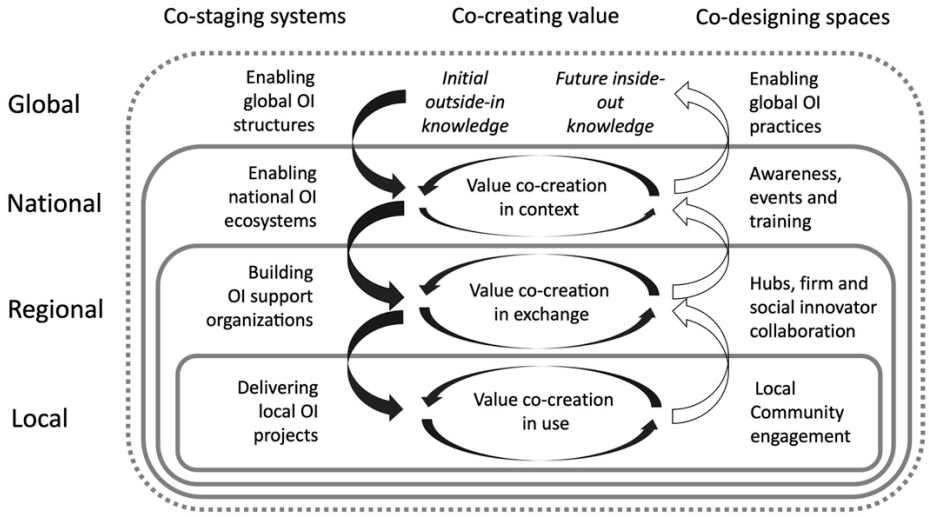


Figure 2. Modelling Value Creation in Open Innovation in University–Industry Collaboration.

3. Results. Nicaragua: A Case of Open(ing) Innovation

This paper examines the Caribbean Regional Communications Program (CARCIP), a USD 22.7 m development project aiming to enhance and enable access to regional broadband networks, while also advancing the development of an information and communication technology (ICT) industry in Nicaragua (https://projects.bancomundial.org/es/projects-operations/project-detail/P155235, accessed on 1 December 2021). With a population of 6.5 mp and a growth rate of 1.02%, Nicaragua is a multi-ethnic, predominantly Christian country with an 82.6% literacy rate, with 59% of the population living in urban areas. The gross national income per capita in 2019 was USD 1847, placing Nicaragua among

the poorest countries in the Western Hemisphere. In 2019, formal employment was 46.9%, with formal unemployment at 5.6% and underemployment at 47.5% (https://www.bcn.gob.ni/sites/default/files/documentos/Nicaragua%20en%20Cifras%202019.pdf, accessed on 1 December 2021).

The overarching CARCIP strategy has aimed to enhance the Caribbean region's innovation potential, noting the lack of a competitive and vibrant environment for technological innovation and the limited capacity and scale in research and development (both physical and human) in the ICT field. Entrepreneurial activity in the area is not fully developed, and national markets are generally seen to be too small to attract significant investment to establish sustainable ICT-based value chains. The project, running from mid-2016 till mid-2022, has been mainly funded through a concessional loan from the World Bank. The project has been built on the premise that higher rates of ICT penetration by developing the technological infrastructure will correspond to enhanced exports (current key exports include beef, coffee, gold, and textiles) and consequent employment opportunities, enabling innovation and increasing the competitiveness of the economy. Investing in technological innovation is seen to also support traditional industries, such as fisheries or tourism services (https://projects.bancomundial.org/es/projects-operations/document-detail/P155235?type=projects, accessed on 1 December 2021).

Recognizing the importance of human capabilities and resources, a project component supports the expansion of scientific and technical information (STI) programs within UICs to connect students with entrepreneurs through nine open innovation hubs across five universities. As innovation intermediaries, these hubs support diffusing OI practices, providing spaces, instructors, and support in ideation, incubation, prototyping, and piloting, and the management of intellectual property rights (IPR). The industry resources and sets real-world challenges, also enabling access to needed information. The project has also supported emerging communities of entrepreneurs and the creation of two open collaboration spaces (InnovaLabs), and has delivered innovation events and contests (hackathons). TELCOR (the national telecom company, Managua, Nicaragua) hosts the CARCIP project implementation unit and global knowledge transfer has been supported by universities from Mexico and Finland.

3.1. Expected Value Creation

The key aims have been to foster the innovation ecosystem through job creation, supporting new enterprises, and enhancing national competitiveness through the adoption of open innovation practices between knowledge creators and industry partners, as well as facilitating knowledge transfers and process reconfiguration across application contexts, while also protecting intellectual property rights. This involved collecting corresponding metrics around economic, innovation, entrepreneurship, and employment variables (numbers of jobs created, patents registered, and innovation centers operating). At the project level, value co-creation expectations involved the development of student skills and talent, and firms building their operations around ICT solutions. Solutions were expected to create new opportunities for partnering firms through rapid commercialization, and through reshaping established patterns. While activities are relatively easy to measure, the changes in mindsets are more elusive and not well addressed in the metrics.

3.2. Project Cases

As the key OI structure within UIC, the nine innovation hubs have been set up and are delivering challenge projects. At the time of writing in late 2021, fifty-eight social innovation-oriented projects have been undertaken, with close to three hundred students and fifteen facilitators, and over two hundred and fifty open innovation events and challenges have been delivered. The following examples show the challenge projects undertaken.

Example Case 1. Bilwi: Improving health in remote communities. After opening the innovation center in Bilwi (Puerto Cabezas in Spanish) in 2018, a challenge proposed by

local health authorities was carried out, which sought to bring medical assistance from more urbanized regions to people living in remote communities. The municipality with a population of c. 123,000 inhabitants (2019) is the capital of the region and of the Miskito nation, a native American community, in the north Caribbean coast of Nicaragua. The existing problems with the infrastructure of the remote communities make it difficult for patients to be treated in hospitals or centers outside their locality. Traditional healers do exist within these remote native American communities, who can be supported and accompanied by formally trained physicians to provide enhanced health services. While this interaction already exists (using WhatsApp messages), the aim was to improve the interaction, provide improved information for decision making, and to address data security through new solutions. These involved building a mobile application, and while some of the communities had no Internet access, the expectation was that services would be provided in due course. The challenge owner engaged very well with the students, with teams perceiving the advantages of the developed solution. Currently operational aspects of the solution are being reviewed. As an area for improvement, there is a need for greater ownership of the application by the secondary stakeholders, and to make them more aware of their role in open innovation projects. Through the project, the university was able to identify gaps within the students' curriculum and learning, such as a focus on mobile application development. The process also uncovered post-degree specialization needs. The students indicated that a key insight involved realizing that they must engage in a self-taught process beyond higher education, while also ascribing value to the solution by itself and the certification in an Android development. While the project partners valued the application as such, seeing it as a step forward towards digital transformation and removing fears towards new technology, the project still remains to be implemented in full.

Example Case 2. Bluefields: Mitigating livestock heat stress. The challenge addressed the heat stress in livestock at the Reforestation and Life Farm linked to the Bluefields Indian and Caribbean University (BICU), located on the south Caribbean coast of Nicaragua. With a tropical rainforest climate, the coastal region has been populated over time by multiple ethnic groups using various languages. The innovation hub set up the challenge related to local rural development needs for a mixed group of university and high school students to study heat stress in livestock. This has been seen to reduce feed intake and grazing hours, as well as milk and meat production, while also lowering reproductive efficiency from 75% to 10%. The team visits to the farm identified several root causes for the stress syndrome, including long distances to watering ponds, poor paddock conditions with a lack of shade and tree canopies, and a lack of genetic compatibility of the type of livestock within the local hot climate. The solution addressed the key issues comprehensively, in consultation with local experts with diverse backgrounds. This involved, among other things, applying appropriate digital technology (e.g., open-source and easy-to-use electronics platforms involving both hardware and software, such as Arduino) to water management and distribution, improving the pumping and thermal control in the watering systems. The challenge project ended up also addressing internal curriculum development at the university to integrate environmental care elements through continuing collaboration with and around the farm. This was seen to allow students to be in contact with real scenarios in rural development, while enabling sustainability at the farm over time. The farm is intended to become a model for others in the region, and while the project has not yet been implemented, it has come to the attention of the university's management.

Example Case 3. Estelí: Conserving and managing water resources. At the Open Innovation Center of the Facultad Regional Multidisciplinaria (FAREM) at Estelí (a part of the Universidad Nacional Autónoma (UNAN) Managua), a challenge was set to develop water management systems for irrigation purposes by applying open-source electronic platforms. The challenge originates from a family of vegetable growers in the proximity of Estelí (officially called Villa de San Antonio de Estelí), a municipality 150 km in the northern of Nicaragua. With a population of c. 109,000 (2020) the municipality is known for its agricultural production, temperate climate, and ease of engaging in commercial activity.

While the region is conducive to high value-added agricultural production, times of water scarcity impact on production and the local economy, affecting also on the efficiency of the use of water resources. The solution to the challenge was to design and build an irrigation system controlled by open-source electronic platforms and programmable microcontrollers using humidity sensors. In addition to the hardware systems, consideration was also given to a mobile application to provide information for better decision making in water management. The system was successfully designed, built, and installed. The team of this project has exhibited their solution at different events, among them the government-supported Agroinnovation Fair, where the team won a national level second-place prize for their project. This has created positive visibility for other producers interested in the solution. The success of the team has also made them mentors of a challenge of a later season of open innovation. One of the student team participants is a close relative of the agricultural partner of the challenge, facilitating the timely implementation and leading to an ongoing scaling-up of the solution.

3.3. Perception Value Creation

As a key finding, the informants noted that OI has gained ground and momentum within the innovation discourses in Nicaragua, triggering a set of conferences, hackathons, innovation contests, events, and spin-off projects around the country, promoting OI and entrepreneurship. As an example, the Creative Economy (CE) initiative, set up by the government and supported externally, promotes the local creative economy through an adapted OI approach, with the project lead noting that " ... we are a country that follows a start-up model with open innovation ... ". At the same time, the interviewees also noted that the process of adapting OI to the local context and culture is still ongoing and in its early stages. Those working within the project model appear converted, but face challenges in convincing others. Improving intellectual property rights and the ability to monetize initiatives have been seen to impact negatively on enterprise creation.

As seen in the example cases, the wide geographic dispersal and a social innovation focus may contribute more to rural and area development than the build-up of a focused critical mass of ICT-related entrepreneurial skills, a shift away from the original value creation expectations. Good examples of success stories and local testimonials are as of yet scarce, but positive signs exist, as indicated by a senior innovation leader: "for the first time in our history, entrepreneurs in our country won the Latin America innovation rally. The mindset of our talent has shifted radically, and we know that the best things are to come in the near future ... ". The interviews point to significant perceived value creation through enhanced connections and a culture of collaboration within and between universities. Engaging with OI has legitimized the participation of the private sector, and collaborations across the challenges have changed the way in which participating instructors carry out their pedagogic activities related to innovation and entrepreneurship.

The newfound openness and collaboration between knowledge creators and the industry has also created opportunities to apply knowledge to new application contexts as universities move closer to other societal actors and each other. As an innovation hub leader notes, " ... our university can see the impact of innovation hubs through a natural interaction with their environment. This kind of connection is new for us and for the organizations that participate in the open innovation challenges. As professor, I can apply tools and practices that I teach, students can see how is that reality [...] I am also changing my teaching practices with collaborative sessions ... ". That said, the roles and responsibilities still need defining, and revenue generation remains an issue as, traditionally, universities have mostly not been paid for their knowledge services or for the use of their research facilities. Both universities and project directors voiced their concern about the future implementation of the projects and the potential impact on continuity, as new sources of external funding are needed when the project ends. The interviewees indicated the need to educate the private sector on the value that universities generate, while noting that new-found collaborations may well be hindered by the competition for external funding. A

senior university leader notes that " . . . there are still few collaborations with enterprises (private sector), some of them sees this projects as academic and not necessary business related, we need to develop trust with them . . . ". Additionally, a central manager indicates that " . . . (it) is necessary to robust the model in order to be attractive to investors capital. We need to teach enterprises that ideas, learning and access to human capital are valuable for them, not just the products and services from innovation . . . ".

The development of soft skills due to the exposure of students in the industry environments was seen as being highly valuable by the interviewees. The situated learning and knowledge exchange processes built through new relationships enabled continuous learning with external parties and two-way knowledge flows. This has, in turn, resulted in a positive learning build-up of OI practices and skills and better collaboration and trust building. The build-up of the confidence to set up and deliver projects has created an initial virtuous circle that reinforces the diffusion of OI practices. As a creative economy leader declares, " . . . now, we develop our own OI toolkits for craftsman along rural zones, and we are training them in their application. We know how to deploy this OI initiatives into the ecosystems . . . ". At the same time, the project directors shared the concern with universities about the lack of implemented innovations. From the start, the practices of delivering the projects had to be improved continuously, and, as an example, had to move from teaching prototyping only to addressing issues with business development and delivering value to industry. This also was seen to stretch the capabilities of the teaching staff at the universities into new knowledge areas. A former university innovation hub leader and now a central project manager in states: " . . . at our university we have incorporated innovation and entrepreneurship as part of the curriculum. Multidisciplinary projects are now the norm. Innovation hubs position the university in a different way in the region and are a new way of connecting with the environment . . . ". Table 1 presents a summary of the perceptions of value creation from the interviews.

Table 1. Perceptions of value creation.

Perceived Value	Evidence of Value Creation	Key Actors
National level open innovation ecosystem value creation through wide service ecosystem		
Fostering mindset for OI and entrepreneurship	Total of 253 OI knowledge sharing events	Global experts Government actors CARCIP team event participants
Promoting OI ecosystem-wide collaboration projects	Government policy supporting OI projects (e.g., Orange Economy)	
Networked escalation model	Total of 9 OI hubs and 2 InnoLabs	
Regional level university, innovation hub, and firm value creation through intermediary services		
Promoting adoption of OI practices in collaborative projects and teaching	An average of 2.8 successfully delivered OI projects annually	Universities Innovation Hubs InnoLabs Firms Social innovators
Facilitating OI practices in wider participation in UIC	An increase in organizations participating with academia from 3 (2018) to 26 (2021)	
Transforming learning and teaching practice through OI within academia	Integrating OI and entrepreneurship practices into academic curricula and teaching practices (3 curriculum updates across 3 universities)	
Local level challenge project value creation through collaboration practices		
Fostering entrepreneurial and soft skills with participating students	Total of 285 students that report enhanced skill development	Firms Social innovators Students Instructors
Facilitating UIC practices between academia, social innovators, and firms	Total of 26 organizations collaborating actively with universities from start of platform operations	
Promoting two-way learning through OI	Report quantity of projects and changes stated in students or enterprises (interviews and tables)	

4. Discussion

We have examined one of the earliest (if not the first) initiative where OI has been deliberately deployed in Nicaragua as a value-creating approach linking industry, academia, and young talent. The study indicates that the overall rationale for participation in the local UIC appears to be in line with the recent literature (mostly from industrialized contexts). Universities wish to facilitate employment for students and gain external resources, influence, and exposure for scholars [4,5,18]. Students, in turn, are keen on employability, real-world experience, and entrepreneurial opportunity within local entrepreneurial

ecosystems [20,69]. In turn, emerging economy industry partners, as well as early-stage enterprises in industrialized countries, appear to initially seek short-term opportunities through UICs [18]. The core assumption has been that OI can support actors in creating value within UICs by introducing new-to-the-place knowledge and practice to the local context.

Across the case study, notable differences emerged between expected and perceived value creation. A narrow local industrial base, undeveloped collaboration practices, and a global–local asymmetry in capabilities across UIC actors imply the need to initially address the development of the OI ecosystem foundations, shifting the wide expectations of the rapid commercialization of project results more into the future. While the transfer of global OI practices into local application contexts met initial success in gaining institutional bridgeheads, this has not yet attracted sufficient private sector actors to date, perhaps due to a lack of peer testimonials and perceived short-term benefits, and the implementation of proposed solutions remains elusive. That said, participants have voiced great satisfaction for the connections that have emerged between the ecosystem actors. The development of an entrepreneurial culture through the OI events has received national-level attention, building interest and commitment, and new initiatives have been reported in the area on the national level. At an organizational level, participating universities also report clear impact: participating faculty have modified teaching practices and new subjects have been integrated into the university curriculum. The novelty of the OI approach and process has attracted both students and faculty, and innovation hubs have put collaboration platforms in place at pace. While successful, establishing new practices is also disruptive, and existing learning and knowledge transfer practices need reconfiguring. The challenge of sustainability remains, while external resource injections that aim to create incentives to change the ways of working still need long-term consolidation. At the challenge project level, participating students, faculty, social innovators, and firms appreciate the relationships that have grown between themselves, as well as the opportunities to hire talent and to engage in new projects.

4.1. Modelling OI in UIC

In sum, while the value creation perceived to date by the participating actors may not fully match the original expectation, the study notes a general satisfaction with the results and impact so far. In this section, we aim to identify and model the elements at play, and suggest a three-part framework for diffusing OI practices into novel UIC contexts.

a. Co-staging systems

In the first place, we note the macro–meso–micro levels of national engagement with OI: the national, regional, and local levels. We understand that creating the multilevel arrangement in the context of OI involves many actors orchestrating or staging a wide systemic approach jointly. Global OI structures, knowledge, and practices have an impact as the sources of external inputs. We would also expect that, with development, local learning would inform global practice. The national OI ecosystem actors include national government and regional authorities, together with funding institutions and donors. Their context and specific goals are linked to wide social and economic development. At the regional level, organizations such as universities, innovation centers, social innovators, and firms share their resources, create social impacts, and aid the development of skills and the assimilation of the open innovation model into their activities. Finally, at the local level, challenge projects involve communities, teams of students, their instructors, and mentors from participating organizations. As the global practices in OI are diffused throughout the system, interconnected actors on various levels have clearly supported the engagement of the other levels through events and activities. In the case study, the entry point of the new practices was the CARCIP project at the ecosystem level, placing the project implementation unit in a key role as a focal actor in the diffusion process. We note the importance of the endorsement of this championing authority. Individuals within the

wider structure have also adopted different roles over time, supporting the diffusion and creation of connectedness between the levels.

b. Co-creating value

Secondly, we argue for service-dominant logic as the underpinning approach to understanding value creation [12] through OI in UIC. This implies framing value creation as an exercise of co-creation, where actors jointly create value in their interaction. We see the set of services offered by the innovation hubs as a service ecosystem [70] that involves value co-creation in action on three levels: (1) value in context, enabling understanding in and of the wide context and situation of the participants, which influences the appreciation and determination of the value created; (2) value in exchange, taking place in the exchanges of knowledge between universities, innovation hubs, social innovators, and firms, allowing comparing yields to the resources applied; and (3) value in use, happening within the discreet projects and interventions that take up challenges and seek solutions, delivering an understanding of the creation of new resources and the evolution in the capacities of the individual actors as a consequence of OI practice [71–73].

It is important to note that actors will integrate resources according to their capabilities and resources, and within their context. This implies that an externally established initial value proposition set with a global benchmark will only be realized in the function of the (potentially asymmetric) available local skills and competences, including those of collaboration and co-creation. Value creation through exchange, use, or in context is thus heavily dependent on the nature of the process of the transfer of OI practice across application contexts. In an emerging economy with a developing ecosystem and structural integrity under construction, capital and support systems can be scarce. The value co-creation processes influence and enable each other and form a pathway for transferring global knowledge and practice to local contexts. We also assume that, over time, the flow will reverse and local practices in OI will inform the global pool of OI application knowledge.

We furthermore argue that these perspectives are linked to each in cyclic, iterative, and evolutionary learning patterns, initially moving from an expected value creation to a perceived one, with embedded learning loops. While external, global practice is important at the inset of the process, and local learning loops define the long terms success. As knowledge underpins OI practice, we see these learning loops as the enabling mechanism through which knowledge becomes a practically useful resource. We can identify both primary and secondary learning loops [61] at each level, with the secondary loops informing the practice at the adjacent levels.

c. Co-designing spaces

In the third place, entering into new application contexts with new-to-the-place ideas, such as OI, requires safe spaces for iterative development. It appears imperative to establish institutionally integrated places around which to organize activities, and this is the rationale for setting up spaces that cater for OI activities on three levels. Awareness raising, organizing events, and delivering training through courses and workshops supports the emergence of the OI ecosystem, while universities, innovation hubs, and Innova labs are natural locations to host collaboration with social innovators and firms [29]. Furthermore, challenge projects necessarily take place within communities of social innovators, firms, and developers, and within similar social structures, and a safe linking of students to these communities needs to be moderated by the organizations that set up and help to deliver the projects.

4.2. Modeling Transferable Practice

In Figure 2, we present our exploratory model for value creation through OI. As a conversation between expected (gray) and perceived (white) value, the multilevel framework is organized around co-staging systems to set up needed structures, co-creating value to understand how external practice and knowledge can be applied and how they create

benefits, and co-designing spaces that help us to enable the practice. We argue that the nature of OI within UICs is such that concurrent co-evolution is necessary in systems, value creation, and spaces, and that expected value is translated into perceived benefits through a multilevel iterative process. The core assumption is that all of the elements of the framework need to be addressed systemically for the whole to enable transferring OI practices into novel application contexts.

5. Conclusions

This study initially identifies both open innovation and university–industry collaboration as significant knowledge areas with practices that contribute to innovation in industrialized countries. Noting the gap in knowledge around the application of these practices in emerging economy contexts, we studied the perceptions of the value created by introducing these global practices into the Nicaraguan context. By adopting a service-dominant logic perspective, we understand that value is co-created through interaction on multiple levels. We observed the importance of orchestrating or staging the OI system within UICs, through fostering the ecosystem, creating supporting organizations, and delivering challenge projects. We also recognized the importance of enabling activities and spaces that promote innovation. While our findings indicated that the expected and perceived value creation did not fully match, we found encouraging signs that value was created in the build-up of foundational practice that will, no doubt, enable supporting the wider national development agendas. There is evidence of shifted mindsets and looped learning across the system. The study contributes to our knowledge and understanding of the value of applying OI within UIC in emerging economies, hitherto a little-studied theme. By identifying the interconnected knowledge flows and learning loops that underpin practice, we are able to identify the value creation at each level and link them to the orchestration and enabling spaces that support the diffusion of OI practices within UIC. We also proposed a model for the systemic development of enabling structures, value creation, and innovation spaces when transferring practices into new application areas.

We expect this model to be useful as a framework of thought for practitioners when planning and engaging in OI initiatives that transfer practices across application contexts. Establishing expectations and measurement schemes allows stakeholders to make decisions and monitor the evolution of the ecosystem and its components. Understanding that the elements are interconnected also opens novel avenues for future research around the nature of the internal interaction within multi-level modelling. There is also a need to establish in more detail the roles and impact that co-staging systems play in value creation and how innovative spaces can be best co-designed. Still yet, the identified learning cycles will no doubt warrant extensive study, as they are central facets in diffusing OI practice.

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Appendix A

Table A1. Data collection.

Workshop Data Collection: Events, Participants, Themes, and Topics						
Event Date	**Type of Event**	**Participant Stakeholders**	**No. of Part.**	**Participant Institutions**	**Place**	**Themes and Summary of Topics Addressed**
4 June 2018	Workshop facilitation and participatory observation	CARCIP executive team (5), hub leaders (3), university director (1)	9	CARCIP, BICU, URACC	Managua	Defining project scope, general goals, ecosystem assessment, and open innovation expectations What is the situation in the ecosystem? What are the priorities of the project? Why open innovation? What can we expect? Why? How do we measure success? What are going to be our goals?
5 June 2018	Workshop facilitation and participatory observation	CARCIP executive team (5), hub leaders (3), university director (1)	9	CARCIP, BICU, URACC	Managua	
2 July 2018	Workshop facilitation and participatory observation	CARCIP executive team (6), hub leader (2), university director (1), professors (20), SMEs (3), students (15)	47	CARCIP, BICU, and URACC	Bluefields	Open innovation expectations, local ecosystem assessment, university goalsWhat are the needs of the local ecosystem? How can open innovation address those needs? What are the expectations? What can we do? How does it work?
3 July 2018	Workshop facilitation and participatory observation	CARCIP executive team, hub leader (1), university director (1), professors (20), SMEs (3), students (15)	47	CARCIP, BICU, URACC	Bluefields	
3 July 2018	Workshop facilitation and participatory observation	CARCIP executive team	3	CARCIP	Bluefields	Local OI hub goals How can we follow progress? What are the best indicators? How and when to measure them?
24 August 2018	Workshop facilitation and participatory observation	CARCIP executive team (6), hub leaders (3), professors (15), SMEs (3), students (20), other entrepreneurship hubs (2)	49	CARCIP, BICU, URACC, UNAN	Managua	Open innovation expectations, local ecosystem assessment, university goalsWhat are the needs of the local ecosystem? How can open innovation address those needs? What are the expectations? What can we do? How will it work?
25 August 2018	Workshop facilitation and participatory observation	CARCIP executive team (6), hub leaders (3), professors (15), SMEs (3), students (20), other entrepreneurship hubs (2)	49	CARCIP, BICU, URACC, UNAN	Managua	
25 August 2018	Workshop facilitation and participatory observation	CARCIP executive team	6	CARCIP	Managua	Local OI hub goals How can we follow progress? What are the best indicators? How and when to measure them?
19 September 2018	Workshop facilitation and participatory observation	CARCIP executive team (5), World Bank Group (3)	8	CARCIP, WBG4	Managua	Ecosystem value creation expectations How will we know that the project is running well? What are going to be the indicators and mechanisms to know? What is the state of the situation today?
20 September 2018	Workshop facilitation and participatory observation	CARCIP executive team (5), World Bank Group (3)	8	CARCIP, WBG	Managua	
5 May 2019	Virtual workshop	CARCIP executive team	3	CARCIP	Managua (virtual)	Ecosystem value creation perceptions What results are present? Are metrics being accomplished? Why? Do you need to change any success criteria? How? Why? What changes can you perceive this moment?
24 August 2019	Virtual workshop	CARCIP executive team	2	CARCIP	Managua (virtual)	Is open innovation ecosystem delivering value? Why and how? Why not?

Table A1. *Cont.*

Individual Interview Data Collection: Interviewees, Themes and Topics					
Event Date	**Type of Event and Stage**	**Participant Stakeholder**	**Participant Institution**	**Place**	**Themes and Summary of Key Topics Addressed in the Interviews**
10 November 2020	Semi-struct'd interview Stage 1	PMO executive team	CARCIP	Managua	Interviews centered on the ecosystem-level actors on expected value creation at the beginning of the project and the perceptions of value created to date What were the expectations at the beginning of the project? How did you establish success parameters? What is their status now? Who are key players identified? Are there other players or intermediaries? How is the ecosystem of OI in Nicaragua mapped in general? How is the attitude toward OI in the project team? What are the challenges faced by stakeholders in the ecosystem (universities, for example)? Are there other efforts related with OI to date? Are they guided by intermediaries? What are the results of the activities carried out? What is the impact on the ecosystem? What is the impact on every actor—students, universities, professors, enterprises?
10 November 2020	Semi-struct'd interview Stage 1	CARCIP executive team	CARCIP	Managua	
11 November 2020	Semi-struct'd interview Stage 1	CARCIP executive team	CARCIP	Managua	
12 November 2020	Semi-struct'd interview Stage 2	Innovation facilitator	BICU Inno hub	El Rama	Interviews centered on the innovation hubs with expected value creation at the beginning of the project and the perceptions of value created to date What is your relationship with the OI project? When and how did you become involved? What do you know about the project? What was your expectation when you became involved in the project? What are the benefits of the project right now—university, professors, OI hub, students, enterprises, others? Who are the key stakeholders in the project? What are the results that the project generated? What type of projects do you know in the OI Hub? Any concerns? Something that needs to be attended to regarding the project?
12 November 2020	Semi-struct'd interview Stage 2	Hub leader	BICUInno hub	Bluefields	
2 December 2020	Semi-struct'd interview Stage 2	Hub co-leader	URACC Inno hub	Bluefields	
3 December 2020	Semi-struct'd interview Stage 2	Hub leader	URACC Inno hub	Las Minas	
2 December 2020	Semi-struct'd interview Stage 2	Hub leader	URACC Inno hub	Bilwi	
1 December 2020	Semi-struct'd interview Stage 2	Innovation facilitator	URACC Inno hub	Leon	
1 June 2021	Semi-struct'd interview Stage 3	Hub leader	URACC Inno hub	Bilwi	Interviews centered on the challenge projects on the expected value creation and perceptions of value created for the different actors to date. Additionally, to identify the possibilities of implementation that the cases have had In what year was the project developed? Where was the project developed? Were there any problems or blockages in carrying out the project? Was it implemented? What was the value expectation of the students? What was the value created for the students? What was the value expectation of the universities? What was the value created for universities? What was the value expectation of the partners? What was the value created for the partners?
1 June 2021	Semi-struct'd interview Stage 3	Hub leader	URACC Inno hub	Bluefields	
1 June 2021	Semi-struct'd interview Stage 3	Innovation facilitator	BICU Inno hub	El Rama	
1 June 2021	Semi struct'd Interview Stage 3	Innovation facilitator	FAREM Inno hub	Estelí	

Abbreviations used in Table A1: CARCIP: the Caribbean Regional Communications Program; BICU: Bluefields Indian and Caribbean University; URACC: University of the Autonomous Regions of the Nicaraguan Caribbean Coast; UNAN: Universidad Nacional Autónoma de Nicaragua; WBG4: The World Bank Group; FAREM: Facultad Regional Multidisciplinaria.

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