Social innovators as a human sensing network solving humanitarian challenges of the XXI century

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Executive summary: Increasing complexity, and consequent heterogeneity, of societies prevents generalised top-down solutions from understanding in detail, and providing effective response, to problems arising. Empowering 'problem detectors-solvers' appears a feasible way to complement current efforts to solve complex problems through distributed solutions, offering an effective means to increase safety by improving social stability in Latin America. After analysing over 8,000 applications to open innovation challenges in Latin America, we have observed 12 clusters of socio-environmental impact initiatives, generating a distributed network of social innovators.

Tags: social innovation, social entrepreneurship, human sensing network, distributed solutions, open innovation, human sensors, Latin America, semantic analysis, clusters, Socialab

Section 1: Background and introduction

From 2019 to date, Latin America has experienced unprecedented social and political crises; the COVID-19 pandemic and an economic depression of great proportions, all under the shadow of the global climate crisis. During this time, creative and empathetic citizens detected problems 'in the field' and developed new products and services capable of solving some of these issues in real time. These include creating a machine that provides fresh water from air in remote locations; digital platforms that generate income for the elderly; and AI (Artificial Intelligence) powered software that keeps track of COVID-19 patients. They are known as 'social innovators' and have been able to mitigate negative consequences of these crises, contributing social stability in a convulsed region and providing safety measures to a huge, ad hoc complex system – Latin American society.

This case study has been developed together with Socialab, a Latin American impact accelerator and open innovation expert since 2012 with offices in six countries that provides data for the characterisation of social innovators.

The increasing complexity of societies and their consequent heterogeneity prevent generalised top-down solutions from providing an effective response to the problems that afflict them. In that context, empowering problem detectors and solvers appears to be a feasible way to complement current efforts from governments, enterprises, multilateral organisations and NGOs. Against complex problems, distributed solutions led by social innovators can increase safety by improving social stability.

From this reflection a key question arises: is it possible that the individual initiatives of social innovators in Latin America are attending common needs in several places at the same time and without top-down coordination?

Human sensing network

Social innovators have a particular way of sensing the world that differentiates them from other mechanisms in understanding social phenomena as they are capable of transforming day-to-day problems into opportunities and tend to act with creativity to solve them; in other words, "entrepreneurial or innovator action of any kind begins with the recognition of a problem." (Chavez et al, 2017)

As explained by Professor Nick Tyler[1], human sensors can be grouped in three types: i) physiological sensors, related to our body (as taste and sight); ii) environmental sensors, related to how we feel our context (as rhythm or time perception) and iii) interpretational sensors, regarding our perception of society (sense of justice, for example). These last types of sensors are particularly interesting, since they trigger innovators to solve a societal issue by considering their intrinsic motivation, not only explained by external stimuli, but also by the way they perceive reality and their will to modify it.

In that context, this case study intends to understand the

ecosystem of social innovators in Latin America as a distributed network of sensors that can understand social issues efficiently and use their creativity and entrepreneurial capacities to solve them. Moreover, it aims to frame it under a complex systems perspective, which may allow it to map the network and suggest courses of action for improvement.

Section 2: Analysis and insights

Study framework

Due to the nature of the field of study and its difference to human engineered complex systems – such as the construction of a space shuttle – it is unlikely that we can understand this system only by applying the Safer Complex Systems (SCS) Framework (McDermid et al, 2020). Thus, social science tools were considered, using the Social Emergence Paradigm framework (Sawyer, 2005). Both frameworks are used to map the network of 'social innovators as a complex system'. The first framework allows us to characterise the complex system and the second one allows us to focus on the different layers of the complex system so we can suggest different courses of action for achieving successful outcomes, such as maximising social stability by providing new solutions for unsolved issues.

SCS framework

Although the analysed system is ad-hoc and not human-engineered, the SCS Framework is useful to define the main properties of this network of social innovators. This case study assumes that the system meets four main characteristics, as described below.

First, the social innovation ecosystem in Latin America can be considered a self-organised group of people[2] that share the common purpose of generating social impact using different tools and knowledge, without being specifically employed for that matter. It is their individual intrinsic motivation that enables them to act as unique sensors, and these will be considered as nodes of the system in this case study.

Second, as the ecosystem is physically and digitally well connected, from shared offices in coworks to online events, it is possible to detect coupled feedback regarding the stimuli delivered to and from nodes in the system. Once a positive or negative output is generated (for example bankruptcy of a start-up or a successful investment round), the nodes of the system react in non-linear and unpredictable ways. For example, repeating successful investment rounds once one of the innovators demonstrates that it is feasible[3].

Third, social innovators interact with different entities that support their development, from incubators to investment funds, allowing them to cross the semipermeable boundaries of the system. These interactions can change the course of social innovators' development from outside of the system[4].

Finally, the development of new products and services that generate positive social impact is the expected emergent property of the interaction of individuals that comprise the human sensing network.

The main components of the SCS Framework were applied to the system as presented in **Figure 1**, using the assumption that the main goal of this system is to develop and implement new products and services that may generate a positive impact on people suffering from different crises.

At the same time, this characterisation allows us to identify the cases where failure of the system happens, referring to the reduction or impossibility of the correct deployment of novel solutions in society. Some examples of these failures[5] are related to: negative effects of the solutions being implemented (. for example, generating disputes inside a vulnerable community when certain members are benefitting from having drinkable water, while others are not); regulatory prohibition to develop certain services (for example, fintech services that improve individual savings, but can't be implemented because of the lack of legal permits;) or bankruptcy of start-ups as governments take excessive time to pay for services that have already been provided (due to bureaucratic paperwork that has little to do with the quality of the service), among others.

The examples mentioned above raise safety concerns towards the risks in the system that can have negative safety impacts due to its complexity and have the potential to cause emergent safety consequences.

Therefore, the SCS Framework raises the question of how to develop measures that improve social stability through means that cannot be harnessed by governments, corporations or NGOs.

The exposed themes are intended to be addressed through the analysis shared in this case study, with the goal of describing the maximisation of safety parameters to build a successful safer complex system.

Emergence paradigm framework

The previous analysis is still insufficient to explain interactions and emergent properties of this social innovator network, thus it is necessary to appeal to social sciences to understand the social innovators ecosystem as an ad-hoc complex system that emerged through the interaction of innovators, with the goal of finally suggesting lever points that maximise the success of the system.

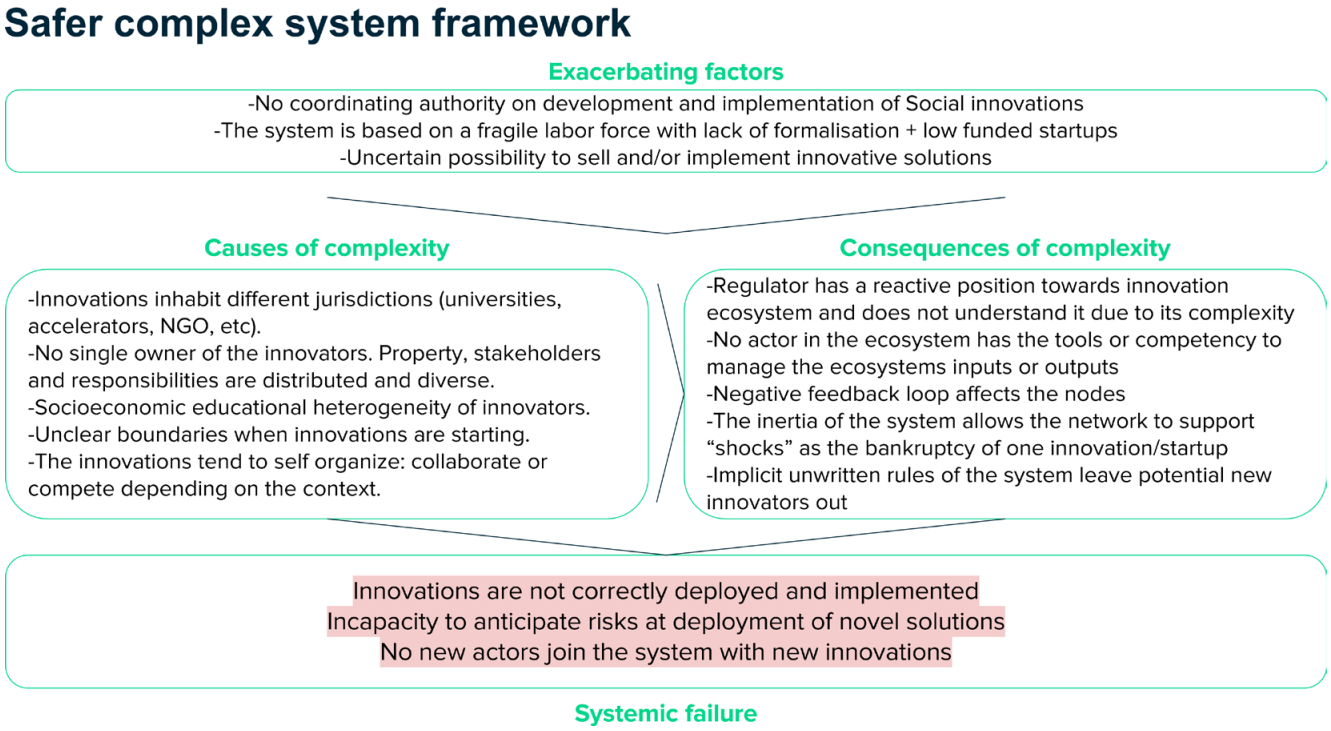

Figure 1: Social Innovators Complex System analysis under the SCS Framework. Details, causes and consequences of the complexity of this system with its exacerbating factors.

To perform the analysis, The Social Emergence Framework was used (Sawyer, 2005). The author sustains that the relationship between two levels, individuals and the social system that they compose is insufficiently explained by the Structure Paradigm that analyses the relationship of the social structure and individuals as a top-down causation where the behaviour of the last is determined by the imperant structure. On the other hand, the Interaction Paradigm – its antithesis – adds a new layer of analysis (interaction among individuals) and emphasises a bottom-up relationship, where individuals and interactions work as creative agents and determine the social structure. As both frameworks prove themselves incomplete, Sawyer suggests the Emergence Paradigm Framework, adding two new levels of analysis that take into account the emerging properties generated by the interactions of the individuals in the system so that, although the norms, laws and other structural elements are generated or inspired by their collective actions, at the same time this structure has causal power over the individuals and their interactions.

The five levels of this framework are described below and the application of the framework to the social innovators case is detailed on **Figure 2**.

- Level E – Social structure: Written texts that rule the system (procedures, laws, regulations); Material systems and infrastructure (architecture, urban design, communications and transportation networks).
- Level D – Stable emergents: Generated subcultures, slang and collective memories; conversational routines and shared social practices.
- Level C – Ephemeral emergents: Determined frame context or topic in which individuals interact; relative roles or status of individuals and their participation structure.
- Level B – Interaction: Symbolic interaction among individuals on the system; processes of collaboration, competition or negotiation; discourse patterns between them.
- Level A – Individual: Specific characteristics of the individuals as their personality, purpose, cognitive processes and specific capacities.

Figure 2 helps us understand the social innovators network as a system built upon five different levels from the social structure to the individual's characteristics, in particular focusing on Levels C and D where emergent properties appear.

This framework is relevant since it makes it possible to propose different leveraged actions and apply them in each level in order to maximise the probabilities of success of the expected emergent properties; moreover, it can allow us to understand how actors can traverse different levels to incentivise change that allows safer outcomes of the system.

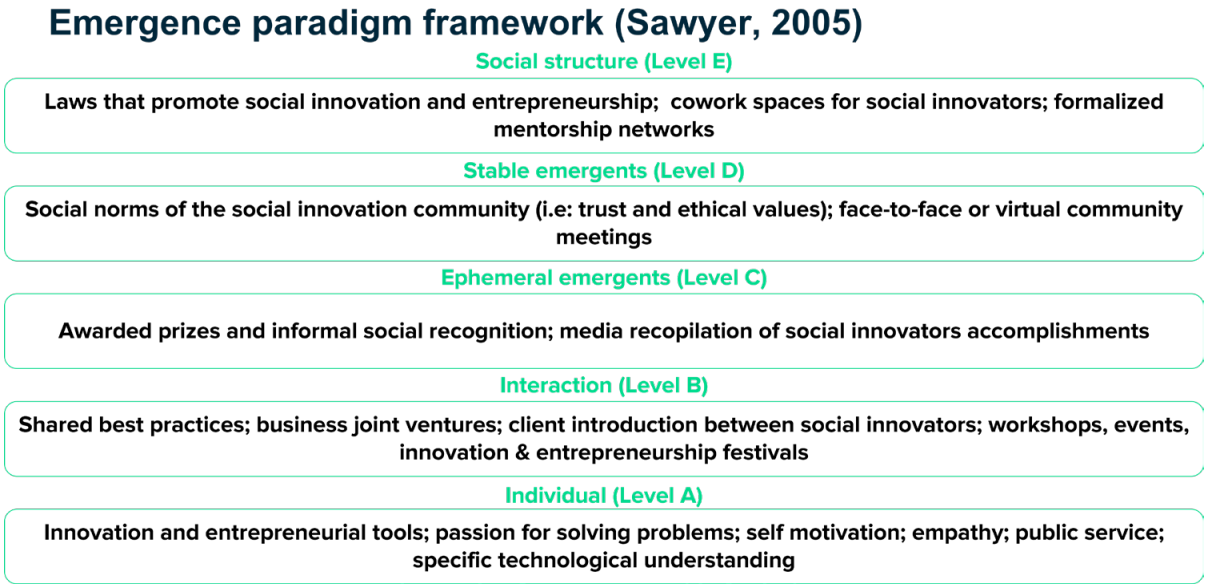

Figure 2: Social Innovators Complex System analysis under the Emergence Paradigm Framework, where the main elements of the system are grouped into five levels.

Available data

Socialab is a social enterprise that provides corporate venturing services to corporations and governments and works as an impact accelerator for start-ups. Through open innovation methodologies[6] Socialab has received more than 75,000 applications since 2012 from innovators in Latin America that have detected a problem and developed a solution.

The starting point for this analysis is a non-structured text database of applications received between 2018 and 2020 from 14 countries in Latin America, from which a subset of 8,353 entries from innovators who have uploaded their proposals was selected. For this case study, those entries and the innovators behind them are considered as the social innovators ecosystem. Additionally, the innovators were asked to answer a short survey for a deeper characterisation.

Results and insights

After conducting the survey and analysing the data from the proposals, it was possible to describe the findings in four main themes.

Theme 1: Understanding the human sensors, motivations and connections

With the goal of conceptualising the network as a complex system, a survey[7] was sent to and answered by a group of 171 social innovators. It covered questions related to their intrinsic motivations and their relationship with other innovators. All the responses correspond to Latin American-based social innovators and the three most represented countries were Chile (28%), Colombia (14%) and Argentina (5%), while the remaining 53% was distributed among 11 other countries. The main results are summarised below:

- Motivation: 33.9% of the respondents declared that their main motivation to solve social issues was the moral duty to contribute to society, followed by 19% who were motivated because of directly suffering from the problem and 18,4% who believed in social innovation as an interesting career path. On the other hand, 7.9% of respondents confirmed that they were motivated by their close circle of people. This answer reveals that of the subset of respondents, the main motivation was to identify a problem and act out of a strong sense of justice and solidarity.
- Needs: The respondents declared that their main difficulty in developing their innovation was access to funding (67.3%) and communication about their project (44.6%). On the other hand, 17.3% of respondents declared that they needed specific knowledge or expertise and 14.3% argued that they needed additional help to understand the problem. These answers give us a hint on measures that need to be taken to maximise the actions of these sensors.
- Recognised nodes: The survey asked respondents to identify the three most important social innovations in Latin America and the following are the five most frequently mentioned in the survey: *Algramo* with 20 mentions (start-up that reduces the use of plastic through bulk sale), *Greenglass* (reusing bottles by turning them into glasses), *Laboratoria* (training vulnerable women in programming tools), *Techo* (NGO that provides housing solutions and community development in slums) and *Balloon Latam*

Figure 3: word cloud of the most recognised social innovations in Latin America

(delivers entrepreneurial and leadership capabilities to rural communities). Figure 3 represents the frequency in which these initiatives were mentioned.

- Relationship with the network: Regarding the main reasons that make social innovators connect with each other in the ecosystem, the most mentioned were that they learn from their knowledge and experience (57.4%) and receive contacts that help them develop their initiatives (46.1%). 2.6% declared that they prefer working alone.
- Requirement for enabling interactions: From Socialab's experience regarding the relationships between social innovators, it is possible to witness that there is no formal contract or transaction that links them, but still, they generate collaborative interactions spontaneously. In that sense, different enablers are thought to be promoters of that collaborative culture: mutual inspiration, geographical closeness, related impact areas and trust, among others. This last one is particularly broad and interesting to understand. To deepen understanding about the meaning of trust in this context, a specific question was asked: "Identify the main characteristics that make other social innovators trustworthy.". As it was an open question, multiple answers where received, from which the most frequent are highlighted: evidence and transparency of the impact they generate; perseverance; coherence between what is said and done; empathy; genuine and unselfish desires to solve a problem; optimist vision; creativity; leadership; technical capabilities and closeness to the problem.

The results of the survey and its main conclusions allow us to conceptualise the network of social innovators in the form of nodes and links that shape to a complex system of sensors, as shown on **Figure 4**.

Theme 2: Mapping social innovations

Through the text generated by 8,353 applications received by Socialab and 24 open innovation calls from 2018 to 2020, it was possible to vectorise them into a 400-dimension space. Vectorisation was performed by using the machine learning algorithm word2vec (Mikolov, 2013), where semantic representations are learned from Spanish words using the full Wikipedia in Spanish[8]. To represent sentences, all words were averaged to compose each proposal after removing 347 stop words[9]. To visualise the proposals, we use a tSNE algorithm (Van der Maaten, 2008) to project proposals into a two-dimensional space in which each proposal is represented as a node on the graph in **Figure 5**.

The position of the nodes on the graph forms a graphical representation of the mapped social innovations where their proximity to other nodes represents a semantic similarity and their position on the graph represent distance units between them, not making reference to specific measurements (meters, pixels, etc).

Vectorial representation of innovations allow us to define a cluster hierarchy by using a Dendogram procedure. The above-mentioned algorithm revealed 12 areas of impact that the innovations addressed. After that analysis, each cluster was named by the analysis team, taking into account the main concepts and related words presented in **Figure 6**. It was possible to determine which subgroups of social innovators aim to solve different problems. Considering our initial premise, it appears that due to the topics discovered, the network of social innovators can also be understood

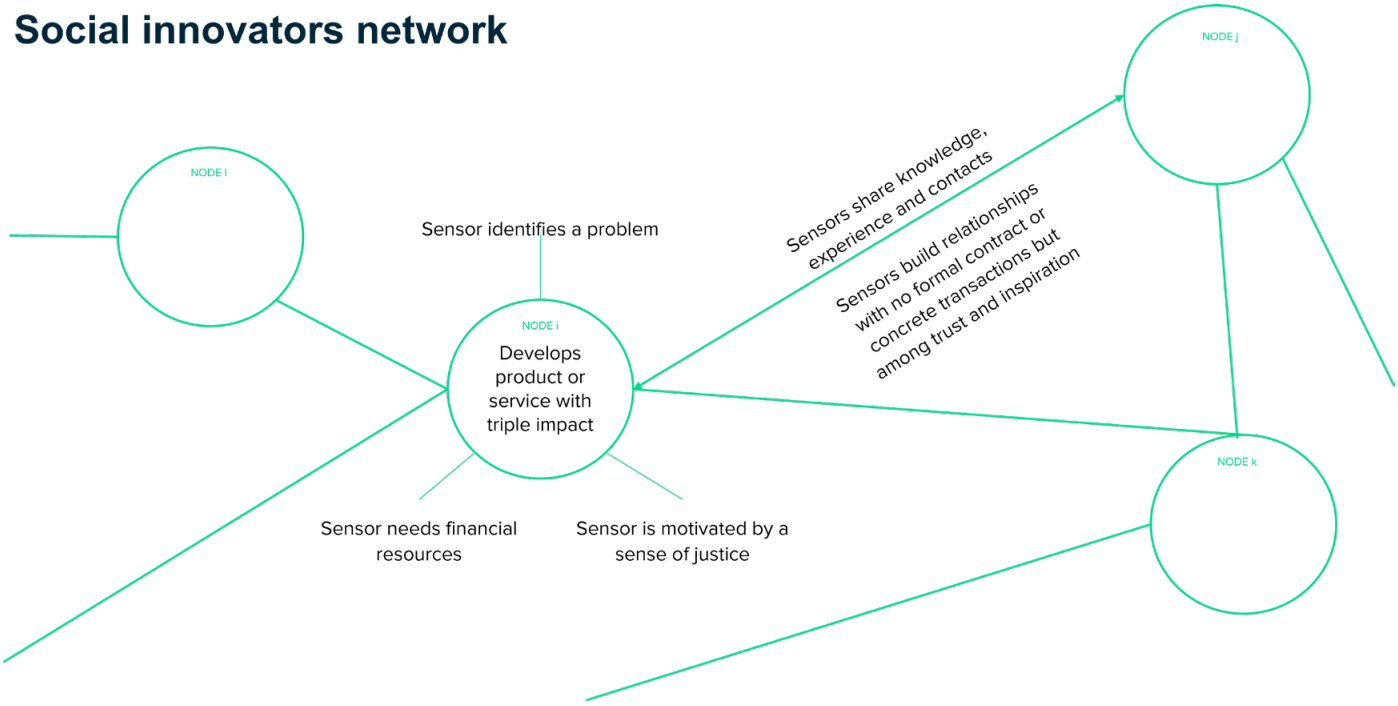

Figure 4: representation of the social innovation ecosystem as a complex system where each node represents a social innovator.

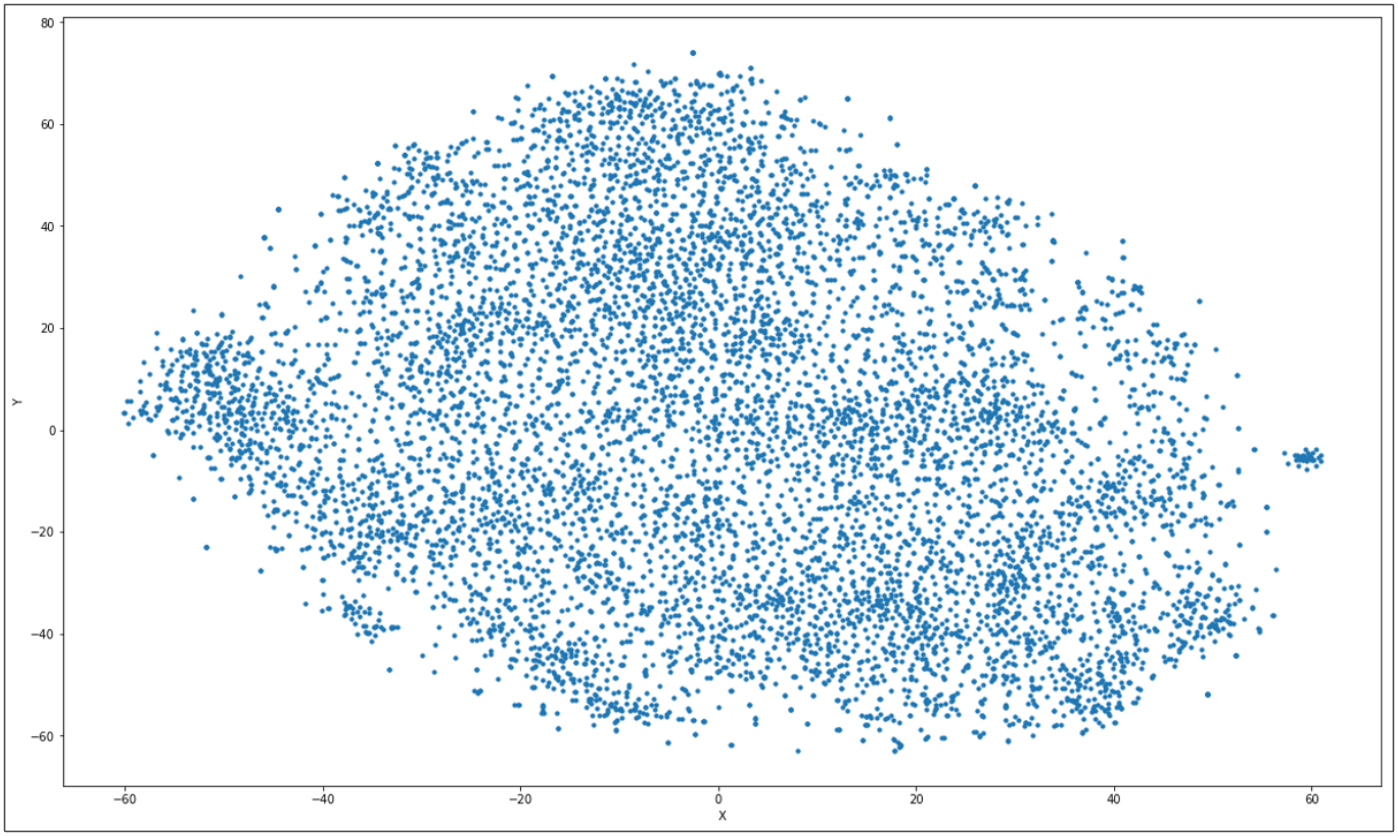

Figure 5: representation of the 8,353 nodes of the social innovation ecosystem in a two-dimensional space.

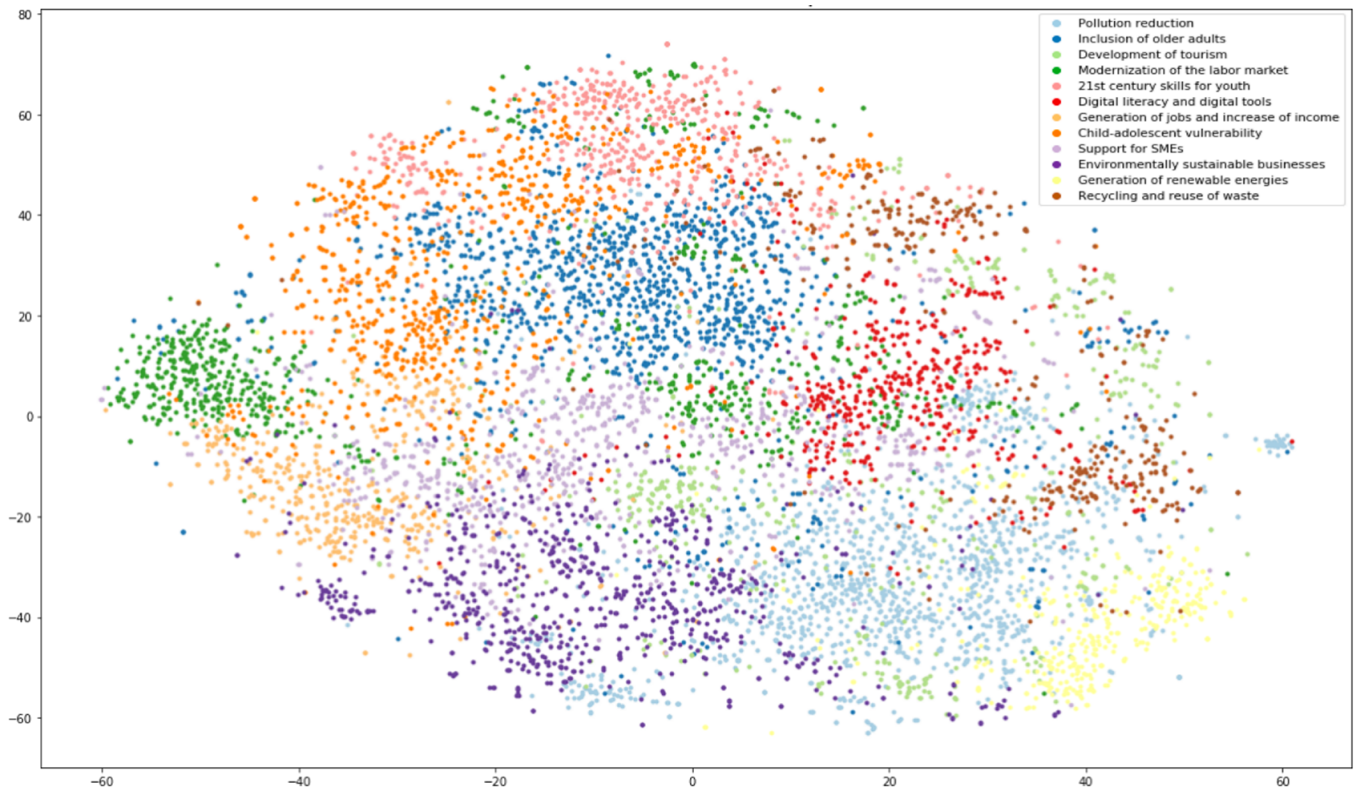

Figure 6: representation of the clusters found that group the main themes social innovators aim to tackle.

as an additional safety net to traditional mechanisms (for example public policies) that aim to design and implement new products or services to improve twelve pain points in society that these human sensors detect as relevant and actionable.

Performing a further analysis, it is possible to determine similarities between clusters that were grouped according to four major themes of socio-environmental challenges, as seen in **Table 1**. In the same table, it is possible to appreciate the frequency of each cluster, allowing us to understand what could be the most pressing issue that innovators sense and try to solve through their proposals, where the environmental (2,787) and the economic reactivation (2,425) themes represent the majority of proposals, followed by inclusion (2,090) and education themes (1,021).

Each of the 12 clusters has a centroid that represents the social innovation that best fits the cluster according to the text that describes it. In **Figure 7**, it is possible to see the distance between a particular idea and the centroids of each cluster. In this example, Servisenior is an online platform that connects older adults with micro tasks that generate them monetary income. It belongs to cluster 6 (red) and is nearer to clusters 4 (dark green) and cluster 2 (dark blue).

Table 2 shows an example of the word cloud generated from cluster 2 – inclusion of older adults – in Spanish. Highlighting the most frequent words and the identification (ID) of the centroid node.

Theme 3: Distribution by year and sex

To understand the evolution of the issues sensed by the network every year, the percentual change of each cluster was compared for each of the three years in which proposals were received. As shown in **Figure 8**, the amount of received ideas varies mainly in three clusters: i) constant increase of proposals in the pollution reduction cluster from 2018 to 2020; ii) significant increase (2% to 12%) in support for SMEs from 2019 to 2020, probably related to the economic crises derived from the COVID 19 pandemic; iii) the significant reduction of social clusters 2 and 8 from 2019 to 2020.

Though it is not possible to determine correlation or predictive capacity of social innovators and the main challenges society faces, it is interesting to analyse how these sensors perceive the change of priorities each year.

Other variations are not significant and can be attributed to biases induced by the title or theme of each open innovation challenge.

Additionally, a similar analysis was performed regarding the gender of social innovators and their presence in the different clusters, as shown in **Figure 9** as the number of innovations proposed by men (M) and women (F). The undetermined gender is

Environmental clusters	Inclusion clusters	Economic reactivation clusters	Education clusters
Pollution reduction (C1=1,313)	Inclusion of older adults (C2=1,268)	Development of tourism (C3=477)	21st Century Skills for Youth (C5= 549)
Environmentally sustainable businesses (C10=755)	Child-adolescent vulnerability (C8=822)	Modernization of the labor market (C4=782)	Digital literacy and digital tools (C6 = 472)
Generation of renewable energies (C11=367)		Generation of jobs and increase of income (C7=431)	
Recycling and reuse of waste (C12=352)		Support for SMEs (C9=735)	
2,787 total proposals	**2,090 total proposals**	**2,425 total proposals**	**1,021 total proposals**

Table 1: 12 clusters of impact areas in four main themes (# of proposals)

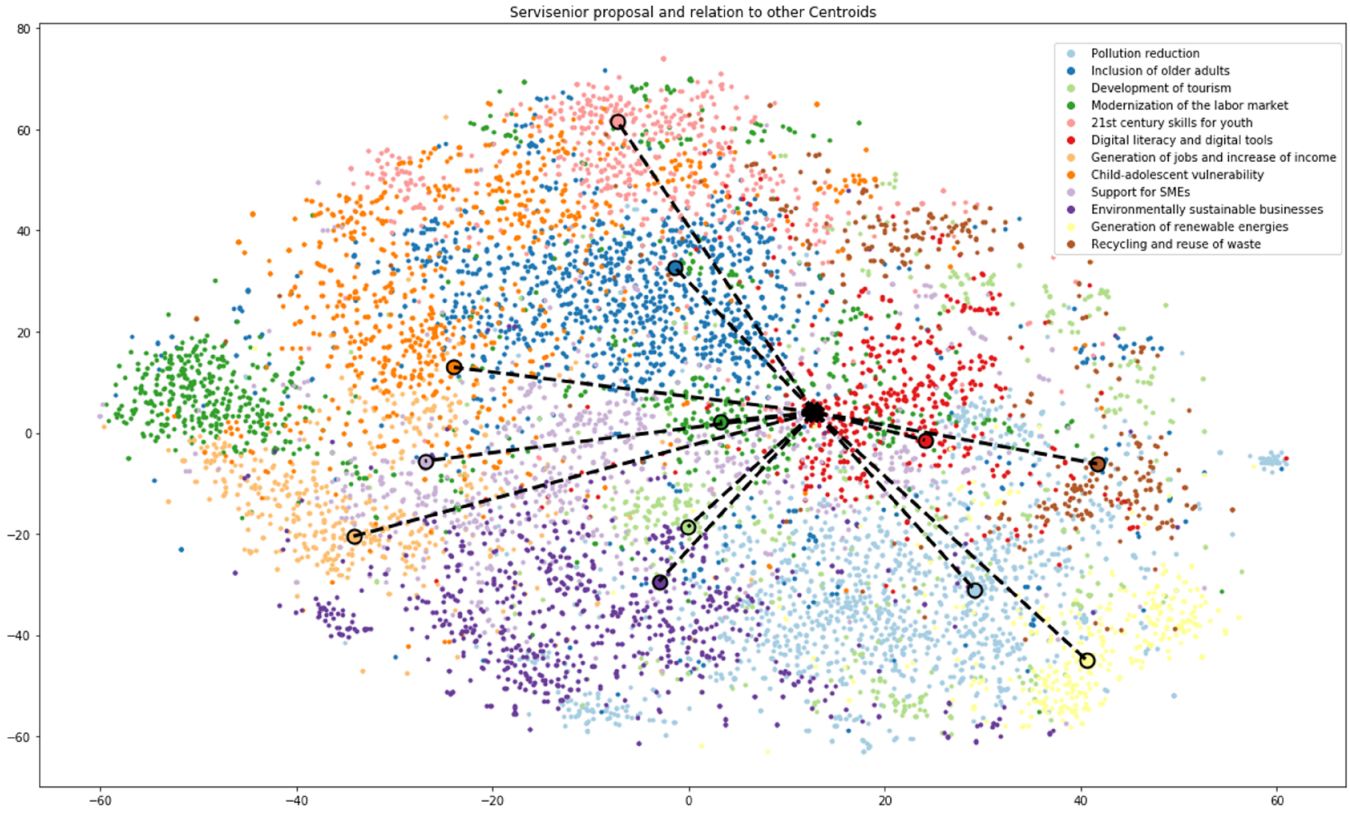

Figure 7: distance between a specific node (Servisenior = ID 120382) and the 12 centroids

represented with a letter A which could not be detected by the algorithm that had higher than 90% accuracy on assigning sex through names.

Using this gender estimation, it can be seen how certain topics are mostly proposed by women (child and adolescent vulnerability, inclusion of older adults), and others by men (reduction of pollution, modernisation of the labour market or support for SMEs).

Theme 4: Limitations of the clustering

The 24 open innovation calls from which the analysed proposals come had different themes through which social innovators were invited to upload their ideas. Though most of them aimed for a broad set of problems to be solved, for example How to live well for 100 years, some looked for specific solutions, such as Chile Breathe which searched for mechanical ventilators to support COVID-19 patients. In particular, only three of the 24 challenges have

Word cloud (Spanish)	Top frequent words	Centroid nodes
	1. Mayores (elder) 2. Adultos (adults) 3. Salud (health)	• 103598[10]

Table 2: details of cluster 2

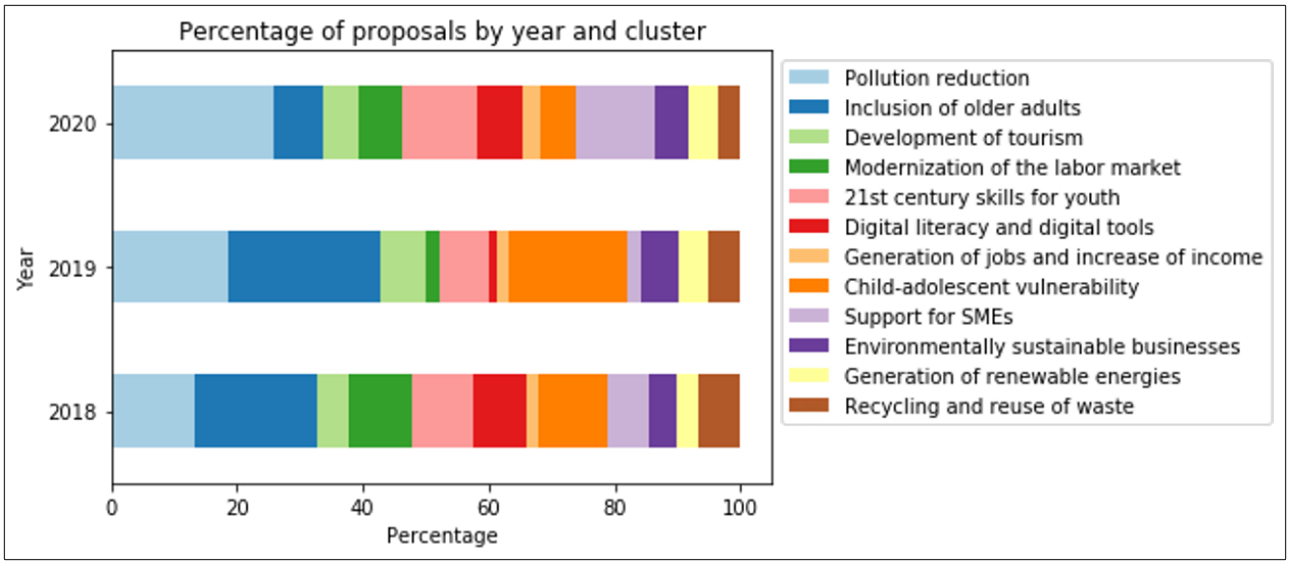

Figure 8: distribution of ideas received per cluster every year

less than six clusters represented, which invites us to think that the differences in the calls, given the high number of proposals, might not have relevant biases between years nor challenges regarding their representativeness in the clusters. The mentioned challenges are presented in **Figure 10**.

Although the analysis shows high diversity, it is not possible to conclude that the innovation calls are totally unbiased due to the following reasons: socio-demographic composition of the users of the challenge platform and Socialab's social networks might be targeting a certain archetype of social innovators; the difference in the incentives for each challenge might be focusing on certain types of innovations (i.e. software); lack of focused challenges on hard-to-tackle issues may be preventing the reception of proposals related to government corruption or geopolitical conflicts, among others.

Nevertheless, the current analysis of the social innovators ecosystem is based on a broad and representative spectrum of innovations in Latin America which allows us to draw conclusions within the mentioned limits.

Section 3: Discussion and transferable learnings

Key findings

Using the proposed frameworks, it was possible to conceptualise

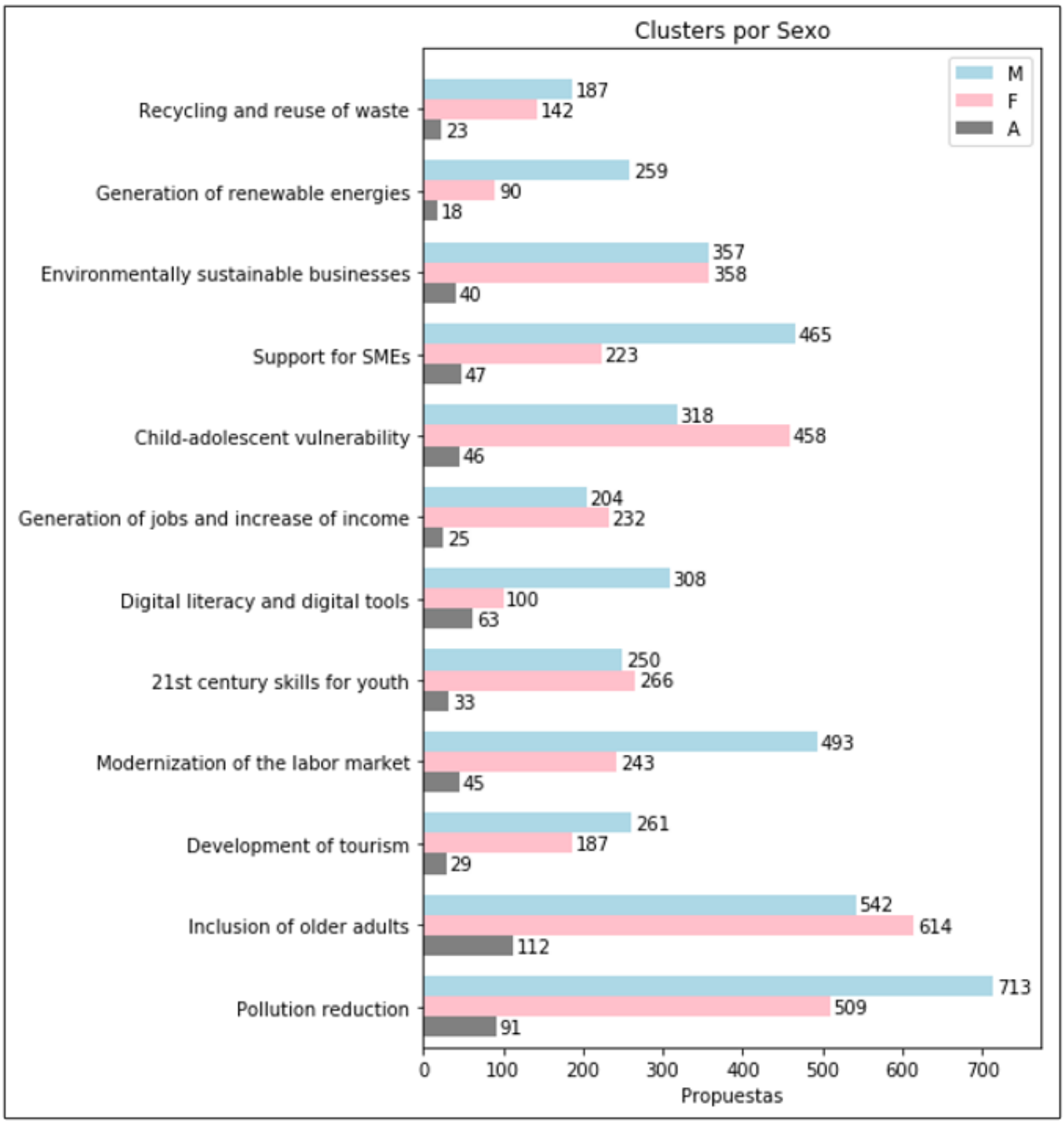

Figure 9: distribution of clusters per gender

this civic society response to social issues as a complex system of human sensors that are able to understand and decode the sophisticated and heterogenous problems of modern societies and can work as a massive and autonomous social impact research and development department.

Despite the great diversity of innovations on different topics, it was possible to narrow down the proposals to 12 areas of socio-environmental impact detected by these sensors. The clusters give us a thermometer of the main priorities that a segment of the citizenry detects and acts on. Additionally, variables such as gender and the year of application can vary the relevance of the different detected issues and thus could be considered to complement actual tools as surveys or impact studies.

The links between the nodes represent the interaction between social innovators and can be a key to strengthening the network. General topics appeared as relevant variables that could determine the state of the relationships as: interchange of knowledge; perception of trust; sharing of contacts; and financial support.

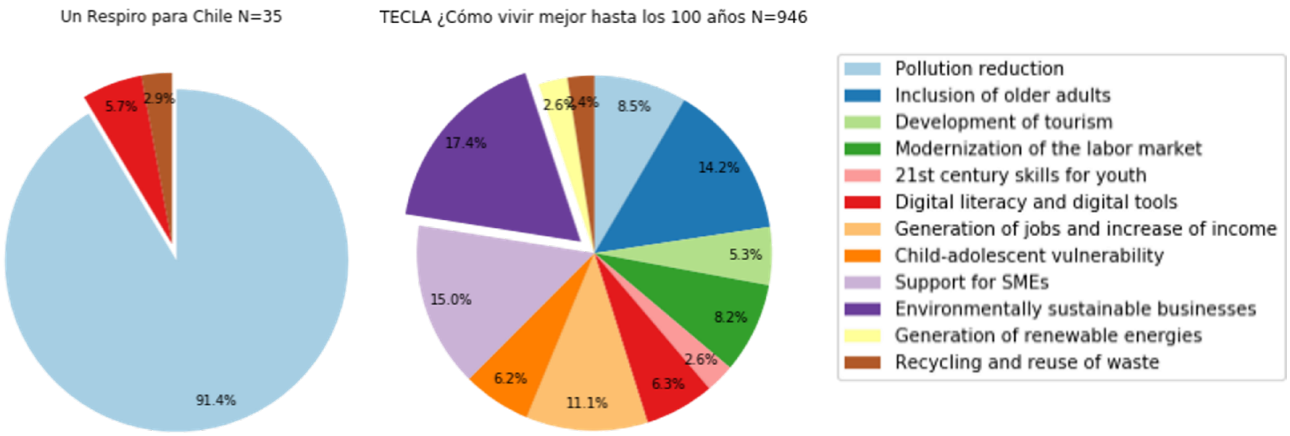

Figure 10: distribution of clusters in two different challenges to understand potential biases regarding the topic of the open innovation challenge.

Additional actors in the social innovation ecosystem must be considered when this complex system is mapped because semi permeable boundaries allow interactions that can deliver or take valuable resources to and from the system as investment funds, accelerators, government agencies and enterprises, among others.

The social innovation ecosystem is still working in silos in the sense that each innovator, incubator or investment fund, among others, pays attention to their own limited field of work and does not necessarily use a systems perspective that would allow them to increase the connections shown in Figure 4 to promote the success of the whole system. These actors are still lacking concrete actions that remove barriers to collaboration and enriching the links between nodes, for example sharing good practices among incubators, co-investing in start-ups or unifying impact measurement.

Aiming for a safer complex system

The prevention of systemic failure by increasing safety of the system is referred to as allowing a fertile ground in which innovators can create, connect with others and have the necessary tools to ensure positive impact once their new products and services are implemented; not only focusing on this last output but also on the whole innovation process, from initial motivation and problem sensing to technical capabilities for correct implementation.

On the other hand, social innovators and their solutions play an important role in solving issues that other actors, such as governments, corporations or NGOs, cannot tackle because of their advantages in agility and speed on sensing and solving problems. Therefore, they contribute to social stability in convulsed societies, building safer complex systems.

To ensure safer outcomes, different design and operation controls are proposed within the leverage points of the system, outlined below.

Understanding the leverage points of the system

Using the Emergence Paradigm and applying the key learnings from the survey and clustering analysis, we can identify five types of leverage points categorised within the levels explained in section 2.

The proposed leverage points that are shown in Table 3 were developed through a Systems Aikido perspective (Webb et al, 2010). This proposes the constant redesign of the system by redirecting its own momentum and self-organisation properties to generate change with minimal energy expenditure in opposition to 'brute force' that attempts to control several inputs over the system with great effort, being often insufficient when dealing with the complexity of social systems.

Conclusion

Understanding this global network of sensors and innovators represents an opportunity to enhance another line of defence against the problems that the public, private and third sectors have not able to tackle in the dawn of the 21st century.

This overview of complex systems incorporated into the Latin American social innovation ecosystem allows us to reveal a hidden force that, starting from civil society, intends to face relevant and actionable challenges. This ad-hoc system of human sensors is yet an invisible force, complementary to governments, enterprises and NGOs and capable of detecting problems and generating solutions individually, while at the same time promoting itself as a large thematic research and development department of social impact that contributes to bringing social stability to one of the regions most affected in the world by the COVID-19 pandemic.

Furthermore, the vision of safer complex systems allows us to

Levels	Suggested leverage actions to be taken
Social structure (Level E)	1. Governments and other institutions officially acknowledge, validate and communicate evidence of impact generated by social innovators. 2. Promotion of focalized policies by gender according to the area of impact to be promoted. 3. Deliver financial resources to specific clusters so they can accelerate the test and implementation of social innovations.
Stable emergents (Level D)	4. Consolidate, communicate and periodically update social norms agreed upon the nodes of the system in a code of conduct.
Ephemeral emergents (Level C)	5. Create awards for measurable impact from social innovations, not only their *elevator pitches*[11]. 6. Encourage transparency among impact indicators to foster trust among social innovators.
Interaction (Level B)	7. Reinforce and promote channels and interactions that foster the mutual admiration and inspiration feedback loops between nodes. 8. Implement peer to peer revisions of risks matrix of innovations prior to their implementation.
Individual (Level A)	9. Reinforce the sense of justice social innovators have and channel that energy towards the possibility to create new products and services. 10. Communicate to social innovators that they are part of a system and that there are others like them with a similar purpose. 11. Reinforce already existing empathy through cultural change campaigns.

Table 3: Suggested leverage points to maximise systems outcome

understand that for the socio-environmental problems we face today, there are no problems to solve, but rather systems to be optimised.

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Endnotes

1. Information raised during an online conversation taking place in April 2020.
2. As reported by Socialab's accelerators specialist, during acceleration Bootcamps each of the 24 cohorts of selected start-ups from 2018 to 2021 have generated spontaneous and unplanned activities and interactions as: informal meetings, networking sessions

or formal workshops, sharing their knowledge among others.

3. After the $85MM USD investment in NOTCO in 2020 (vegan food producer that lowers CO2 emissions), a series of new investment rounds have been raised by Chilean start-ups for more than $200MM USD until April 2021. That shows a 'snowball effect' in the social innovation ecosystem (Article in La Tercera, Chilean newspaper in Spanish).
4. Since 2010 at least 15 high impact accelerators have been created to transfer economic resources and knowledge (Article in Latinamerican Reports).
5. Declared by Socialab's accelerators specialist through a virtual interview.
6. Open innovation methodology consists of the posting of an online challenge with the invitation to contestants to solve a socio-environmental problem, offering an award to the best innovations.
7. The summary of the survey in Spanish can be seen in the following link and was only sent to Spanish speaking countries (Brazil was excluded from this analysis).
8. The analysis excludes applications in Portuguese; thus, Brazil is not included in this case study.
9. Common words that don't add valuable information to the analysis, mainly articles.
10. Identification number given to each of the analysed proposals (applications).

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Affiliations

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