Unexpected reflections towards transformation: Second Order Learning from the Covid-19 Pandemic. Preliminary insights

Figure 1: Covid-19 in one word[1]

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August, 2020.

1. Scope of this research

The Transformative Innovation Policy Consortium (TIPC)[3], a global research and policy-oriented community analysing systemic transformations, is an ideal organisation to assess how may the COVID-19 pandemic impact sustainability transitions of socio-technical systems. Observing a "major landscape shock" (Kanda and Kivimaa, 2020) with dramatic global consequences and pervasive effects may thus become a singular event to reflect on second order learning processes and potential changes. Therefore, the purpose of this research is to explore **how has COVID-19**

[1] This is the result of the ice-breaker for the first online workshop. Participants were asked to mention the first word that came to their minds when thinking about the pandemic.

[2] Special thanks to Professor Ed Steinmueller from SPRU, University of Sussex, for commenting the first draft and to Imogen Wade for accompanying the process and editing.

[3] See the TIPC website: http://www.tipconsortium.net/

contributed to a change in beliefs, assumptions, points of view and behaviours that are relevant for transformation. TIPC community is the realm to be explored.

Interpretations of second order learning (hereafter SOL) are diverse in the sustainability transitions literature (Van Mierlo and Beers, 2018; Schot and Geels 2008, Geels 2002, Geels and Schot 2007, Schot and Steinmueller 2018). For the purpose of this research, we will use a combination of different approaches to SOL from three strands of literature that have a similar understanding of second order learning and shared elements of how it may occur: 1) transitions theory; 2) organisational learning and 3) transformative learning in education.

The SOL characteristics will be empirically explored through a contemporaneous situation: a sample of TIPC members dealing with the Covid-19 pandemic from an individual, community, and organisational perspective while also asked to reflect purposefully on what this pandemic may mean for their current and future work with sustainability transformations, for their contexts and for the global panorama. This process is based on a reflexive conversation, understood as the subjective reframing about our own ideas and beliefs (Mezirow 1997:7). A prevalent shock affecting everyone may serve as a good excuse to observe if SOL happens as a result from the crisis, despite the lack of distance with the object of research which has for long been on debate (Escalante, 1999: 9). While there is not enough evidence yet to argue that other pandemics such as SARS and AH1N1 have caused SOL in knowledge based organisations[4], the impact of Covid-19 seems to be considerably more extensive in terms of registered cases, social and economic consequences and deaths.

The structure of the document is as follows: In section 2, we explore a definition of SOL and its main characteristics. Section 3 presents the methodological approach and section 4 shows preliminary findings. Finally, in section 5, we discuss the reflections about SOL in the Covid-19 context, and in section 6 we present potential next steps to explore.

2. Theoretical framework. Second order learning in transformative innovation

Learning is a fundamental concept, "a core feature of transitions" that can be found everywhere in the transitions and in the social change arena, usually either as a "steering mechanism" (van Mierlo et al., 2020: 251) or as a "transformative outcome" (Ghosh et al., 2020: 10).

In transitions, "the diverse, well-established research fields related to learning are broadly ignored or loosely applied" (van Mierlo and Beers, 2020: 255). As a result, a plethora of adjectives can be observed when researchers refer to learning: first and SOL (Schot and Geels, 2008); first, second, third and even quadruple loop learning (Argyris and Schon, 1996; Patton 2011; Pahl-Wostl, 2009; Lee, Hwang & Moon 2020); deep learning (Schot and Steinmueller, 2018); social learning (Pellicer-Sifres et al., 2018; Luederitz et al., 2017), transformative learning (Mezirow, 1978, 1991 and 1997), and many more. Some of these labels overlap to some extent in meaning.

[4] Dorr, Huijskens and Scholten, 2020, TIPC working paper about historical cases.

Assuming that learning is indeed relevant, and that sustainability transitions require a *specific* type of learning which is different to learning without adjectives, diving into other literatures may help us understand how learning for transitions happens and how it could be induced.

Transitions theory, organisational learning and transformative learning in education have a similar interpretation of what SOL is, usually linked to the distinction between first and second order learning[5]. In first order learning, people learn and improve their usual processes but do not change "fundamental assumptions, values and identities"; whereas in SOL, those underlying notions are subject of learning and change (Grin et al 2010: 280; Mezirow, 1997).

Beyond this framework, it remains to be further explored whether the distinction between first order learning and SOL is as clear in the sample's experiences, whether assumptions, values and identities may also change as a result of other processes that do not relate to learning and whether some degree of SOL may expand through choice and a shock.

The Transformative Innovation approach highlights the importance of SOL. One of the transformative outcomes (#2) proposed in TIPC (Schot et al., 2019: 26; Ghosh et al., 2020) focuses on broad and deep learning understood as "gathering new knowledge as well as questioning assumptions (second order learning) within the experiment". In the words of Ghosh et al (2020:11), SOL is "a cognitive change in which the web of facts and understandings is re-configured in a new pattern. It focuses on challenging the existing rules and specifying new rules (behaviours, beliefs, values)".

The three strands mentioned --transitions theory, organisational theory and transformative learning theory--also share the vision that some circumstances may induce SOL. These events are referred to as a "negative surprise" within transitions theory (Grin et al., 2010), a "crisis precipitated by a context event" in organisational theory (Argyris and Schön, 1996), or a "disorienting dilemma" for transformative education (Mezirow, 1997). Covid-19 is therefore considered a "major landscape shock" because of its pervasive effects across socio-technical systems (Kanda and Kivimaa, 2020).

Another common trait in the three literatures is reflexivity. For transitions theory, a key element is that the landscape shock is reflected upon by the actors involved or brought to their attention, mobilized so as to persuade them (Grin et al, 2010; Ghosh et al., 2020). The learning "*needs* to be reflexive" (Schot et al, 2019). Exogenous events make established courses of action, and the underlying convictions, no longer appropriate if such events are "being noted" by those actors. Schön and Rein (1994: 176–178 quoted in Grin et al, 2010:281) add another important condition for SOL: exploiting the "situatedness" of action. Situatedness is understood as the involvement

[5] Argyris and Schon talk about double-loop learning instead of second order learning, and they say it occurs when "error is detected and corrected in ways that involve the modification of an organization's underlying norms, policies, and objectives"(1996: 3-4.) For the purpose of this research double loop and second order are considered the same type of learning.

of the researcher and participants within a context[6]. For transitions theory, it helps to make actor's inquiry conducive to frame reflection and therefore change.

According to Argyris and Schön (1996) people in organisations usually have a narrative that they explicitly advocate ("espoused theory") and very different implicit processes to plan and carry out their actions ("theory in use"). Very few people are aware that they do not use the espoused theory, and few are aware of the theory they truly use. Significant organisational learning happens after a comprehensive intervention starting from an inquiry as a reflexive process. Similarly, Mezirow (1997) details that for a disorienting dilemma to generate transformative learning, there needs to be an individual examination, a "critical reflection" to construe new meanings through examining beliefs and a "rational discourse" to discuss with other people.

Another relevant issue worth considering is how "espoused theory" and "theory in use" may work in practice with organisations that are specifically dealing with change as part of their routines, as is the case with a transitions research community such as TIPC. If the everyday work consists of revising the establishment and evolution of routines and then the processes so that those routines effectively change (Grin et al, 2010). Routine assessment would actually become the espoused theory and it is yet unclear whether there is a known theory in use that is being permanently revisited. The similar could apply to educational research where communities aim to promote learning as an individual change.

In contrast to meaning, reflexivity and catalyser events, *what* changes varies in each literature. For transitions theories, changes occur in *frames* and *assumptions* to transform "underlying *rule-sets* that drive the system" thus leading to changes "in cognitive *beliefs* and *values*"(Schot et al, 2019). For organisational theories, people modify their theory-in-use and therefore the set of "*strategies* and *assumptions*" is what changes (Argyris and Schön, 1996). In transformative learning, the *frames of reference* are what changes, understood as all the structures of *assumptions* through which we understand our experiences. They encompass two dimensions: *habits of mind* and *points of view*. Habits of mind are broad, abstract, orienting, habitual ways of thinking, feeling and acting influenced by a set of codes. Points of view are subject to continuing change as we identify the need to modify assumptions when actions do not work the way we anticipated. A resulting point of view is the complex of *feelings*, *beliefs*, *judgments*, and *attitudes* we have regarding specific individuals or groups (Mezirow, 1997, 5-7).

This research we will focus on beliefs, assumptions, points of view and behaviours[7] relevant for SOL assuming that a better understanding of SOL is indeed relevant to promote sustainability

[6] Sage Encyclopedia of Qualitative Research Methods, 2008: 815.

[7] According to Oxford Learner's Dictionaries, a belief is a strong feeling that something/somebody exists or is true; confidence that something/somebody is good or right. An assumption is a belief or feeling that something is true or that something will happen, although there is no proof. A point of view is the particular attitude or opinion that somebody has about something. A behaviour is the way that somebody functions or reacts, especially towards other people.

transitions in different contexts beyond this community. Table 1 compares the three strands of literature.

Table 1 Second Order Learning according to different literature strands

Second Order Learning	Definition	Characteristics	Events that may provoke it	Purposefully induced?
Transitions Theories	Changes in frames and assumptions; transforming underlying rule-sets that drive the system; change in cognitive beliefs and values;	It is reflexive, situated, key for transformation, implies directionality	A surprise or course of action with unanticipated effects, a landscape shock.	Some external influence is needed so that changes in routines leading to SOL may occur
Organisational Theories	Double loop learning as rethinking fundamental assumptions built into strategy, values, views and understandings	Needs to be induced as natural inhibitors operate such as suppression of feelings and avoidance of conflict	A crisis precipitated by a context event such as a revolution from within, from without or created	Yes. Through critical inquiries and specific interventions
Transformative Learning Theories	Change in a frame of reference or structure of assumptions including cognitive, conative and emotional components leading to changes in habits of mind and points of view	Results from a significant disturbance leading a person to examine and reflect, it needs to be accompanied by critical reflection and rational discourse	A disorienting dilemma leading people to undergo a meaning perspective transformation	Yes, through individual examination, a critical reflection and a rational discourse.

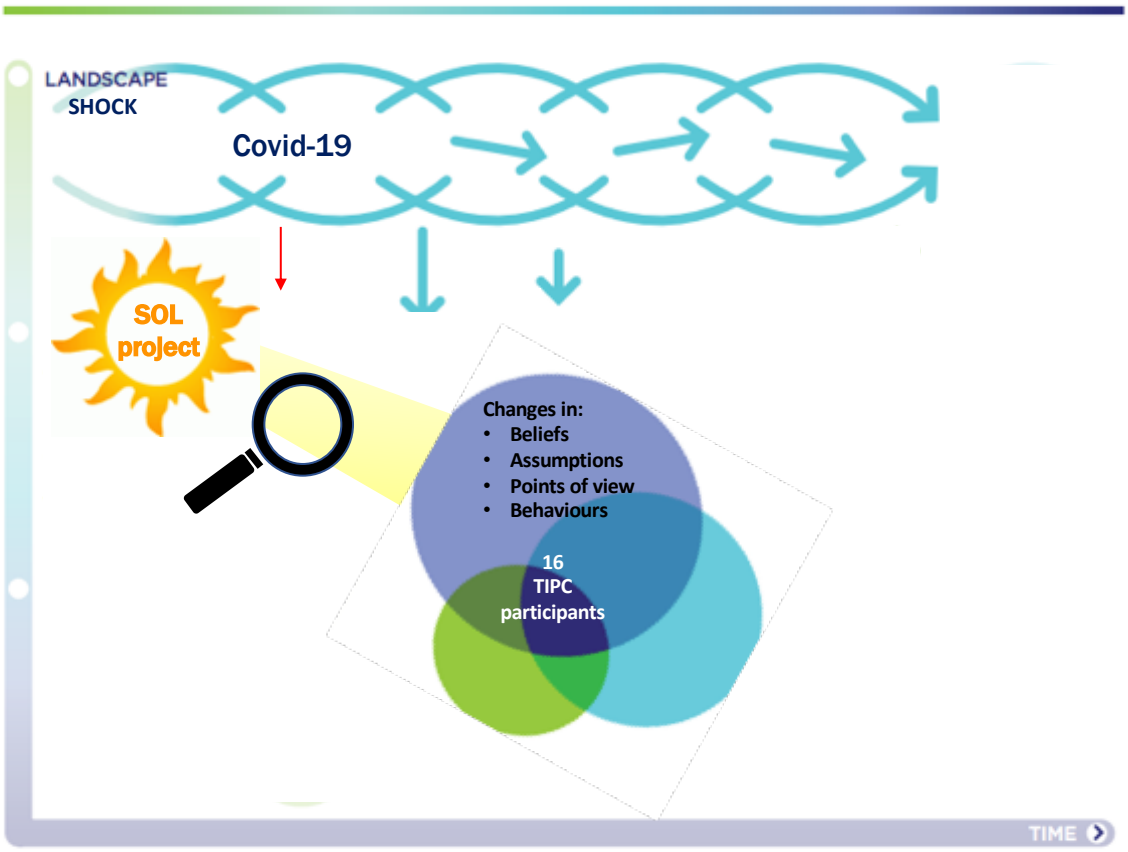
The following insights from the literature will be explored in this project (Figure 2):

a) SOL implies changes in beliefs, assumptions, points of view and behaviours (Ghosh et al., 2020; Schot et al., 2019; Argyris and Schon, 1996; Mezirow, 1997).

b) Unexpected shocks, crisis or disorienting dilemmas such as Covid-19 may work as "drivers" to enact second order learning (Grin et al., 2010; Argyris and Schon, 1996; Mezirow, 1997).

c) Reflexive inquiries or critical reflection and situated learning enable those changes (Schot et al., 2019; Argyris and Schon, 1991; Mezirow, 1978).

Figure 2 Second Order Learning from the Covid-19 pandemic in TIPC



3. Methodology

A sample was built to explore TIPC community of research and practice with as much diversity as possible regarding location, type of work, gender and age within the organisation. Sixteen participants from the various range of contexts and projects were interested in this topic and agreed to be interviewed between May 26 and July 7 (participants and its countries are presented below, annex 1 shows the semi-structured interview questions). The first virtual workshop to engage in a conversation about Covid-19 and SOL took place on July 7.

Figure 3 Map of project participants' country of origin or main work project

This map was created in Mural and used for the presentation section in the virtual workshop.

Table 2 Project participants (country alphabetical order)
Interviewees who attended the First Virtual Workshop are marked with an asterisk (*)

Interviewee	Country/Institution
Pablo Villalobos	Chile/U. de Talca
Salim Chalela Naffah *	Colombia /UNAULA
Geovana Vallejo*	Colombia /UNAULA
Carmen Bueno *	México /UIA
Elisabeth Gulbrandsen*	Norway/RCN
Glenda Kruss*	South Africa HSRC
Il-haam Petersen*	South Africa HSRC
José Manuel Martín	Spain/ Climate KIC
Ana Belda	Spain/ UV
Josefin Lundström*	Sweden/Vinnova
Jan Sandred*	Sweden/Vinnova
Geraldine Bloomfield*	UK /Sussex
Vicky Shaw*	UK/Sussex
Bipashyee Ghosh	UK/Sussex
Matías Ramírez	UK/Sussex- Hub Latam
Chux Daniels	UK/Sussex- Hub Africa

Interviews focused on the impact of Covid-19 on individual, community, organisational, national and global levels to assess how changes coming from the different levels of analysis are perceived. While individuals are not representative of their organisation or countries, the reflexive space intended to grasp the transformative innovation perspective and situated challenges during the pandemic. The workshop opened up the space for a broader conversation about STI and SOL.

Interviews were done in English and Spanish depending on each person's preferences. Coming from eight different countries and nine institutions, interviewees generously shared their individual and social circumstances, perspectives about their own communities, working organisations, countries and the global situation. Additionally, they described how they envision the Science, Technology and Innovation system and agencies amid and after the Covid-19 shock. All interviewees were given a reflexive exercise about the learnings from this experience. While the focus of the interview was mostly on impacts and the focus of the exercise was mostly on learnings, several participants considered this exercise a bit of an overlap. A random number was assigned to each person in order to respect their privacy and this number does not correspond with the table above. For the purposes of this report, information coming from the reflective written exercises and comments coming from the workshop are all considered as an extension of individual interviews (int.) and referred to accordingly (literal quotes in bold).

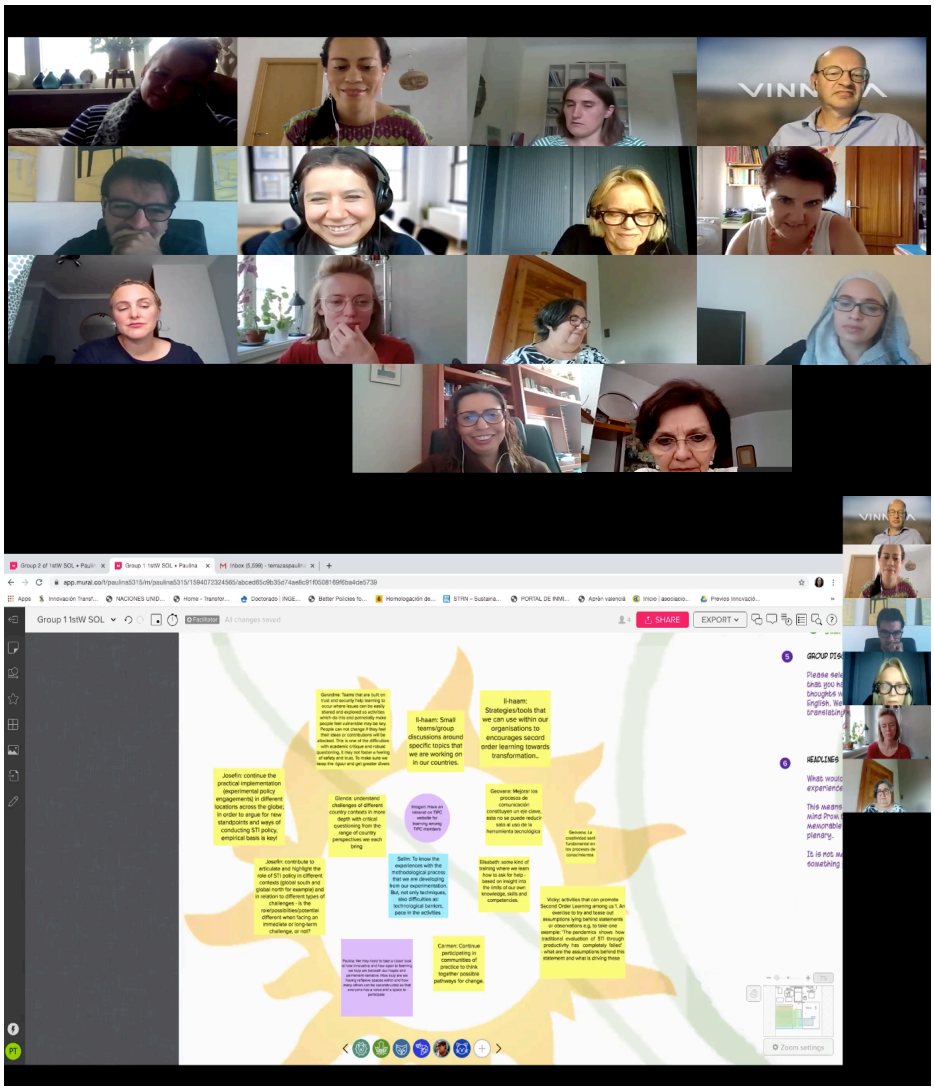
Ten of the sixteen interviewees were interested and able to participate in the first virtual workshop to share their thoughts with this community and engaged in what most considered an appropriate "space to give their opinions"[8]. The workshop consisted of a virtual meeting where participants shared their preliminary thoughts about Covid-19 and its effects on the Science Technology and Innovation system and then reflected upon how Second Order Learning could be promoted in our own community of research and practice.

Of the six interviewees missing to the workshop, three were part of TIPC's internal team and wanted to attend but had other pressing commitments in their agendas, two other interviewees had previous meetings at the same time and one found the time slot impossible due to childcare duties. Figure 4 shows two pictures of the workshop (annexes 2 and 3 show the detailed agenda and the anonymised results of the visual dialogue in Mural).

Workshop participants easily engaged in a peer-to-peer conversation, only interrupted by technical issues to access the forum material at real time. From the variety of issues opened up for comments upon which they included their own perspectives, the most significant topics highlighted were: deeper thoughts about the future role of STI and its agencies after the pandemic, relevant differences and lessons about the Global North and the Global South, and how Covid-19 has exponentiated previous social challenges in all contexts.

[8] All feedback form answers to the question about an overall impression of the workshop strongly agreed on that.

Figure 4 First Virtual Workshop



4. Preliminary insights

4.1. Reflecting on the personal realm

It is unusual for policy and research professionals to engage, as part of their normal work day, in conversations about something that may be considered as a personal experience. This trait is explicitly studied by organisational experts (Argyris and Schon, 1996) as a key inhibitor of SOL.

People tend to "suppress their own and others' feelings" and "emphasize the intellectual and deemphasize the emotional aspects of problems"[9]. Covid-19 has all the elements to be

[9] Chris Argyris (1977), "Double Loop Learning in Organizations", Harvard Business Review. September 1977 Issue.

considered a dramatic crisis, a perfect disorienting dilemma, a challenging unexpected situation as by the literature. This shock has prompted us to share our habits of mind and points of view including perceptions, values, cognition, feelings and expectations[10] as never before.

Participants were sometimes surprised about having to talk about their own situation and feelings. Some of them even sought to confirm whether they were supposed to respond at a personal level (int. 3,4,5,8), but everyone ended up being open about it. A slight gender difference may be seen with men being less prone to sharing details about their individual and familiar situations than women.

At the beginning of the interviews, several participants mentioned that their lives have "not changed that much" (int. 5, 12,**15**). When interviewees went into detail about their daily routines, in fact, everything had changed for all. The entire structure of how a day goes by is now very different. There is no commuting in general, no going out to work, online or stressed shopping, a very intense nuclear family interaction time, a lack of social interaction, a persistent effort invested in feeling normal, and an underlying pressure to work online as if nothing had happened.

4.2. Coping with Covid-19 effects

Covid-19 has brought a very clear impact on daily activities: all interviewees have shifted to working from home. Several persons with no small children or dependent adults, and a full access to infrastructure, equipment and connectivity have even found a positive effect from this change. A slower pace, being able to concentrate more, having less activities, engaging in more "efficient" online virtual meetings, not having to invest time in moving to work, being obliged to travel less, being closer to nature and having a "better air quality" were mentioned among the new normality perks (int. **1**, 5, **7**, 8, 9, 10, 12,14,16). Some doubts about what going back to work after the pandemic will mean came up, as certainties about the fact that work will change for good: "the question then is really, if we go back, how will some of these things work then? shall we go just back to normal or do we change it a bit?" (int.3,4,6,7,**13**).

For interviewees with children, the confinement has been a completely different story. They usually struggle to get any work done as their organisations expect, while having to dedicate most of their energy to deal with childcare activities. To deal with this enormous daily challenge, they work shifts, sometimes very early in the morning or late at night instead of sleeping, try to support children's learning and online socialising as best as possible and juggle with online work interactions (int.1 ,8 ,10 ,16). Child caring is a full-time activity itself and therefore if children are at home with their parents, normal online work is heroic to say the least. They report "no family and no leisure time" (int. 1). In the best of cases, homes have enough space and parents take turns to watch, teach, entertain and sooth locked-in children that are demanding their entire

[10] Jack Mezirow (1997), "Transformative Learning: Theory to Practice". New Directions for Adult and Continuing Education (74): 5-12.

time, energy and attention. “They are really active and they jump and run. They need to be supervised all the time” (int. 8).

Some participants had to deal with the debilitating impact of having Covid-19 themselves while still needing to partially continue with daily work or childcare activities. One interviewee reported needing emergency extended family support to be able to eat and feed children, as the illness came together with an important reduction of food alternatives. Another person commented that “people are now really noticing how insecure food supply chains are and how it doesn't take much to feel vulnerable about food”(int. 1).

Social isolation is definitely perceived as an important challenge for everyone. While certain novelties from online activities emerge, as everything from international seminars to birthdays and weddings occurs on line, there is an explicit understanding and hope that this is just a temporary arrangement to manage the epidemiological threat. Weekends are now completely different: “before Covid we would actually visit a lot of friends and family, get together, spend a whole Saturday” (int. 2,3,4,6,7, 8, **15**). Covid-19 has definitely changed dramatically social interactions. “Several of my friends are now only interacting with a very small group of people, I have spent three months without touching anyone myself…” (int. 6).

A common coping mechanism is to try and find positive aspects of the crisis and some interviewees shifted from extremely negative news to figuring out something good out of it (int. 9,14,15). “You can really see the good side of society in these crises where you know people think about other people and not just their self-interests” (int. 15). Still, anxiety and uncertainty are the common ground (int. 5, 8, 9), sometimes more explicit and assumed, sometimes more discreet, but they are definitely a constant. Some degree of these feelings may relate to empathy as in extreme alterations of routine, sharing and “helping others” may become more relevant (Sterling, 2020).These feelings may come with more tangible problems such as insomnia (int. 6, 9, 16) as people are very worried about getting sick, about their families getting sick, about their jobs surviving the downturn, about their countries and futures in general (int.1,6,9,10, 11,14,16).

Some interviewees reported spending a lot more time in certain activities than ever before, sometimes due to more intense demands and less possibilities to refuse interactions (int. 4, 11,14). While some time gains from not commuting are present, some people also confessed the need to invest considerably more time in feeling well enough to function, given the overall situation (int. 8,9,16).

Team leaders are under specific pressure as they need to stay well and productive, deliver relevant products and documents, as if nothing was happening, while taking responsibility for their teams “life, health and wellbeing”(int. 9), while pushing for them to have adequate connectivity and to continue work. Some feel overwhelmed by the amount of new online tasks and online meetings (int. 1,4,6,9,14). The lack of physical presence makes it hard to have quick feedback of ideas and to brainstorm issues. It also implies a major challenge in communication (int. 5,6, 9, 11) and team building: “it is easy to underestimate the importance of being physically social in the long run”(int. 7). In addition to previously planned work, new concerns and projects

about Covid-19 have logically added to the workload while teams remain the same and have more pressure over time-usage than before.

4.3. Challenges for STI agencies

Scientists are human and change is sometimes painful (Sagan,1987).

Science, Technology and Innovation (STI) agencies forming TIPC are dealing with many matters happening at the same time. While usually not directly leading the health response, the agencies are frequently involved with presenting evidence against the Covid-19 menace (int. 9, 12).

While TIPC members maintained their belief in a key STI role towards sustainable transitions (Schot and Steinmueller, 2018), they are mostly facing the pressing challenges in terms of public administration amid an emergency. Many are under pressure to defend its allocation of financial resources (int. 3, 4, 5, 6, 7, 12, 16) while crusading for multidisciplinary visions of a sustainable future beyond health as the sole urgent concern (int. 1, 5, 9, 11, 12,16). Capacity and willingness to shift towards remote and digital work are seen as a result of having adequate circumstances to do so (int. 4,5,7,8,9).

New workloads resulting from the pandemic add up to previous challenges such as an announced restructuring, a shift towards more digital activities and information sharing, or to new political commitments such as a new role in the post pandemic economic recovery (int. 5, 7, 8, 11, 15) Some optimistic readings were shared but also some pessimistic understandings of how the future could turn out to be (int. 4,14).

In contrast with the personal realm, the STI System is a more comfortable topic for all interviewees[11]. In the workshop, participants shared their reflections about what the pandemic has brought to their organisations and activities. To engage in a collective conversation, eleven phrases inspired on the interviews were proposed to open up a reflexive discussion in two virtual subgroups with as diverse characteristics as possible. Table 3 depicts the phrases, they are not arranged in a particular order but included to show the diversity of topics. Participants were invited to aggregate their own reflections to the phrases they considered more interesting to comment. Afterwards, a conversation was structured to share their thoughts.

[11] This matches TIPC main mission as a group of science, technology and innovation researchers, policymakers and funding agencies working together to give substance to a new framing for STI policy, Transformative Innovation Policy. TIP aims to address global societal challenges, as encapsulated in the United Nations' Sustainable Development Goals. http://www.tipconsortium.net/about/

Table 3 STI phrases inspired on the interviews and used on the workshop

1. Science is still very political and there is always more than one interpretation of scientific facts. STI plurality is essential.
2. We think a lot about sociotechnical systems but there is also a need to focus on socioecological systems, nature conservation and ecologically vulnerable regions.
3. There is a very clear case for global knowledge which will make relevant progress eventually available for the entire population.
4. In certain contexts the jump towards technology may be very problematic given the very unequal access to affordable solutions.
5. Interaction between topics becomes more relevant. We are not only talking about health, but also about environment, inequality, transport. A stronger conversation between systems such as food and health may be seen.
6. Despite Covid-19, there is a lot of inertia in the system that might prevent science policy shifting more towards global challenges.
7. The pandemics shows how traditional evaluation of STI through productivity has completely failed.
8. The pandemics shows how traditional evaluation of STI through productivity has completely failed.
9. The war-like modality of STI is getting more attention, but what happens to the other part, the one where we think about how we got into this mess, how we are part of the problem instead of part of the solution?
10. Habits and fear of something going wrong are the largest obstacles to change and transformation within the STI system.
11. As STI is considered key towards a countercyclical response to economic contraction, the need for a more transformative approach becomes clearer.

The more popular phrase was number 10, “Habits and fear of something going wrong are the largest obstacles to change and transformation within the STI system”. It received six comments from the group. Statements included the risk for underestimating the long-term impact and overrating the size of the short-term changes; a clarification that changes always come with tensions and resistance, especially of the dominant values and habits; a reflection about how vulnerability and the sense of being out of control are not conducive to deep transformation or to opening up of ways of working and research modalities; an argument in favour of experimentation and risk which are necessary for transformation but not always supported; a clarification proposing fear of failure instead of fear of something going wrong; and a question about whether these fears are human, organisational or structural.

Curiously enough, this phrase was about habits and emotions. This is consistent precisely with Mezirow's "frames of reference" and with Argyris and Schön's "feelings", usually suppressed in professional realms. It is not totally straightforward why a majority of participants would choose precisely the phrase closest to SOL concepts to comment but this too seems consistent with a more trustworthy and reflexive conversation building up.

The next in popularity were phrases 1 and 7, which received five comments each and propose a more plural approach to STI and argues against traditional evaluation indicators, two very relevant topics but more consistent with TIPC's frame three approach (Schot and Steinmueller, 2018).

Participants all agreed that the pandemic has brought visibility and reflectors to the obvious health related component of the STI community and system. Nevertheless, they also expressed concerns that this has not been accompanied by the deeper reflection on the type of STI that is needed to sort out national and global challenges (int. 4,5,8,9,10,12,13,14, 15,16). The question remains unanswered: "Is science policy now going to shift more to the normative aspects of the grand challenges? Is it getting closer to adopting something like frame three?" (int. 4). Assuming traditional STI role as part of the sustainability challenge itself would certainly help build a deeper conversation (int. 2,3,5,12). Nevertheless, the great extent of attention is going more towards the Covid-19 crisis and its short-term implications (int. 5,7, 11,12).

The governments, the public opinion and the media are all acting as according to a "war-like modality" that narrows the space for broader discussions about a different modality of research that allows for a more open conversation, listening more, including more expressions (int.**12**,13,15). A risk that was explicitly mentioned was that using scientific evidence to take policy decisions amid the emergency may also lead to a misleading perception of singularity or hegemony of 'the science,' This would impede a more transparent and plural debate about both scientific evidence itself and its related governmental decisions associated (int. 5, 10, 11, 13, 14).

Even in institutions and teams that would seem closer to the transformative framework, pressure for traditional indicators, path dependence and historical trends can be easily observed (int. 2,8, 12,14,15,16). While traditional evaluation linked to productivity and economic growth has not sorted out the breach between science and society, that trend still needs to be actively confronted with real alternatives to attract public support (int.2,3,4,5,7,9,10,12,13,14,15,16).

Several participants (int. 5, 9,14,15) were hopeful that the pandemic could open up a space to push for alternative wellbeing, community, environmental and inclusion agendas and indicators. Certain questions about how change happens and how organisational challenges may be surmounted even within STI agencies (int. 1,2,3,4,5,7,10,12,14,15) were present as well. The risks that come with profound change within our own organisations may come with vulnerability, tensions and resistance (int. 5,7,12,13,14,15) although "a more active transition management" could have both immediate and long-term effects (int. 5).

Interaction between topics such as food, energy, mobility and an emergency systemic approach to problems was also considered relevant and increased by having a common mission: "new niches relating food systems, health systems and people participation will have to occur"(int. 1,**3**, 5,6, 8,9,10) although the automatic focus on health remains present. A recognition for TIPC came out in some cases, as well as a definite hope for TIPC to be "more reflexive" (int.1, 5,**12**,14).

4.4. New technological bridges and walls

With or without the pandemics, "inequality in access to knowledge, resources and solutions limit what is possible to do with innovation" (int. 9). A central preoccupation especially highlighted by the Global South participants, involves unequal access to technological infrastructure and services. Many initiatives have taken place to provide equipment and network facilities in different institutions (int. 2, 13). Confinement to reduce contagion risks in countries with an important percentage of the population holding informal jobs becomes a luxury that many cannot afford (int.14,15). The gap therein may truly become larger as families that were originally better off have adequate access to infrastructure, equipment and capabilities to switch relatively easily to working and studying from home whereas other families are struggling to cope. And yet, something about the technological jump still means extra stress and unease. Even some of the sample participants suffered from having to adapt to online tools and reported spending a lot more time than before in very basic activities. "We thought we were much more advanced technologically than what we actually are" (int.11).

The TIPC community of funders, researchers and practitioners is certainly more able to work from home when familiar arrangements allow it. Different perspectives of what this means came out as persons revealed and included their own personal and housing situation. An adequate internet connection for daily activities is sometimes as essential as unpredictable for all contexts. Unforeseen circumstances such as an electricity cut, an operative system breach in an office laptop and incompatibility issues become part of the new normal. Care-related activities remain a challenge both in Global North and Global South contexts as families with young children, senior adults or somebody sick obviously need to dedicate their time to handling that situation and are not even close to recovering their previous time availability. Three members of the group (int. 1,2, 16) held that collaboration should not rely only on more sophisticated technological infrastructure or digital solutions but in social collaboration instead, probably meaning stronger social networks for support for those in more need of help.

A curious taste of what working from home may mean can be inferred from the first online workshop about SOL from Covid-19. Gender inequality, pandemic home arrangements and the still odd online environment made working mothers feel the extra stress of having an online meeting with children around. They either mentioned it at some moment, turned off their microphones and videos to avoid risks or even apologized in advance for having their kids on camera.

The fact that ten participants from seven countries around the world could have a two hour space for a conversation about the impacts of the pandemic on the Science, Technology and Innovation

System is certainly a positive occasion associated to this moment. However, such an opportunity came with a high degree of frustration resulting from different qualities of internet connectivity. At least three persons from the group were not able to connect to the workshop materials due to either internet broadband, hardware issues or other unknown circumstances. Several others were able to connect but had the extra tension of not being able to fully communicate their ideas through an online platform. An important degree of technical support from other TIPC researchers, a variety of alternative options to participate, and a high degree of improvisation to deal with unexpected issues were needed. The format was considered challenging, as, in a participant's own words "all of this digital interaction is rather new to us"(int. **8**, 14).

4.5. Global South challenges

Participants from all contexts recognized that Global South challenges for Covid-19 are very specific. For the Global North interviewees this meant both a very strong conscience about being relatively privileged and also concerns on how the situation is developing for people in other locations. Some critical understandings of how certain opportunities may be missed for "greater partnerships towards a global solution" to Covid-19 were brought about (int. **1**, 5, 10). A greater conscience about how global chains work and about "where basic consumption goods come from" was considered to be more evident than ever before (int. 1, **10**). For the Global South interviewees or related researchers this became a key challenge to their own experience as many of them were still under confinement and/or waiting for the epidemiological peak as of July (int.1,2,3,4,5,10,11,12,).

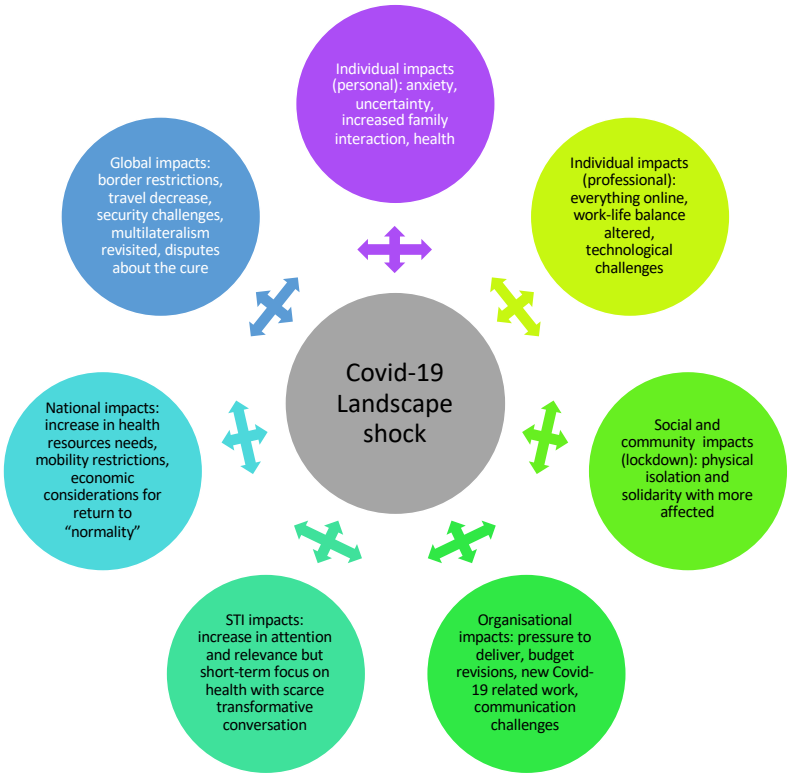
Previously "heartbreaking" social challenges such as hunger, poverty and racism are putting certain populations on a higher risk in pandemic times (int. **9**, 11). The fact that already complex situations become so much worse amid the health crisis is somehow felt by most of the practitioners and researchers regardless of where they are, but the specific details about scarcity are clearly worrying more those who are closer to those issues (int. 9,11,13,14, 15,16).

Known policy challenges such as the "evidence-base", or the lack of enough financial, equipment, infrastructure and human resources at the health systems (int.9,**10**) sometimes add up to other dramatic situations as is the case with natural disasters affecting thousands of people (int. 15). Still, one interviewee from the Global South was positively surprised by the "fast and proactive" institutional and governmental reactions during the pandemic (int. 3).

Covid-19 has brought urgency to previous mid-term plans including transitions towards a more digital work environment and meetings. The risk of this jump contributing to more social inequality was pointed out as the technological skills gap adds up to the educational background (int. 8, 11, 13, 14, 15). Both Global North and Global South interviewees shared the worry that less transparent and open decisions may be imposed top-down under the current circumstances (5,6, 10,11,13,14,16).

Concerns about education and health in the Global South included concrete examples such as populations without adequate access to computers and internet being told to engage in "online classes", or going back to schools in deprived areas where there are no proper sanitation facilities and no water available for students to wash their hands. For several interviewees the actual difference with the pandemic, is that it exponentiates previous social challenges that were already present but no longer given attention as they were part of the usual context (int.4,6,11,14,16).

Figure 5 Preliminary findings in brief



5. SOL and Covid-19

The sixteen interviews and the first workshop confirm that explicit changes about beliefs, assumptions, points of view and behaviours have indeed resulted from the Covid-19 pandemic. A reflexive conversation about situated experiences, considered important in the literature (Schot et al., 2019; Argyris and Schön, 1996; Mezirow, 1997) was promoted. Starting from the personal-individual level, while odd to some participants at the beginning, became a safe space to voice out loud what people have been feeling and thinking and were not always able to share in other work-related moments.

While being obliged to stop the frenzies of our daily routines (int. 2,5,7) could potentially mean having extra reflection time, many participants reported the contrary. They had thus not really thought that much about how this crisis had impacted them (int. 1,2,3,4,8,9,10,12). As a consequence, some interviewees considered these research interactions "interesting" and "useful" (int. 1,5,**9**,10,12,**15**). This would match the logic of an unexpected situation working precisely as a driver of critical reflection which are key conditions for SOL to exist (Schot et al., 2019; Argyris and Schön 1996; Mezirow 1978, 1991) .

While several participants referred only "small changes" in their daily routines (int. 7, **12**,15), the lives and times of the entire TIPC sample has been modified since the second trimester of 2020. Impacts at all levels have resulted from the pandemic shock: an outburst of negative emotions which have had to been dealt with on an individual-nuclear family basis; a complete alteration in family arrangements, activities and schedules; a very hasty challenging shift to online work; social and community isolation occasionally compensated with online social and cultural interaction.

And yet, while narrating their experiences, a cascade of potentially more profound reflections emerged: a general rethinking of what is truly important in life, a reconsideration about family interactions, a reformulation of time usage, an extra ponderation about their work and the role of their organisations, an extra consciousness of certain privileges they have, compared to other locations.

Distinguishing beliefs from assumptions and points of view is not as straightforward as it could seem[12]. Changes in beliefs included: a complicated future due to health and the following economic contraction (int. 1,6,9,10,11,14,16), a conviction about defending their projects from resource cuts so that multidimensional efforts towards sustainability continue (int. 1,3,4,5,6,7,9,11,12,16) concerns about the emergency modality in STI ruling out pluralism (int. 5,10,11,13,14), preoccupation about the worsening of social challenges and access to technology amid the pandemic (int. 2,4, 8,9,11,13,14,15).

Changes in assumptions included: how different individual and familiar circumstances may deeply disturb professional commitments (int. 3,4,5,8), the new role that STI will have in the post-pandemic world (int. 5,7,8,11,15), a different configuration of work as a result (int. 3,4,6,7,13), the possibility to work remotely online if adequate infrastructure, equipment and capacities are available (int. 4,5,7,8,9), the fact that we are not as technological as we thought we were (int. 1,14).

Cognition about how social and community changes may happen seems altered from its foundations, although some participants are still trying to process what this new information may

[12] According to Oxford Learner's Dictionaries, a belief is a strong feeling that something/somebody exists or is true; confidence that something/somebody is good or right. An assumption is a belief or feeling that something is true or that something will happen, although there is no proof. A point of view is the particular attitude or opinion that somebody has about something. A behaviour is the way that somebody functions or reacts, especially towards other people.

mean for their daily activities. “Funding projects is a tool for us to achieve innovation capacity, but there could be other ways like being a neutral partner, for example” (int. **7**, 10,13, 14). Certain assumptions also seem under pressure as work-life balance, the efficiency of the shift to online work, the potential usefulness of scientists being perceived as relevant in the current conjunction.

Points of view also changed: participants considered that there is not enough deep reflection about STI and its implications during the current crisis (int. 4,5,8,9,10,12,13,14,15,16) and yet, some also considered that the pandemic may pave the way towards collective learning which could trigger transformation, although it is not totally clear how that should happen, nor which mechanism will serve such a mission statement (int. 2, 6, 8,9, 10, 12, 15). Feeling well takes a lot of time and effort and is now much more appreciated (int. 8,9,16). The need to showcase more alternative so that short-term views are not the only ones existing (int. 5,7,11,12), as is the opportunity that may be missed for stronger global partnerships (int. 1, 10). A democratic decision deficit concern that was not always there before also became present (int. 5,6,10,11,13,14).

A change in behaviours is perhaps more evident: the combination of childcaring and online work (int. 1, 8, 11,13,14,15, 16), the lack of social interaction (int. 3,4,5,6,7), the difficulty to refuse meetings (int. 4,11,14), the need to pretend you are not as sick as you feel to prevent family and friends to worry more, the forefront apology in online interactions for having children around (int.1,8,16).

The energy drained from technological challenges was more than compensated with the enthusiasm that people had to interact and share their own reflections, projects, findings. Yet, participants recognized feeling “out of their depth” when thinking or discussing about SOL (int.1,10,11,15,16). Individuals from very different contexts and organisations faced many similar issues and challenges despite the nuances of their specific entourages. Building a reflexive space starting with individual impacts was key to start reflecting and then having a common safe topic was useful to open up a group discussion in more accessible terms.

Changes in beliefs, assumptions, points of view and behaviours are thus traceable. Learnings definitely seem situated, linked to the context and culture in which they are developed (Brown et al. 1989, Schön and Rein, 1994) and revealed through the two reflexive spaces proposed, a private interview and a virtual workshop. All of the literature mentioned conditions for SOL to occur are present, and relatively little time has gone by to assess which changes will stick around.

6. Next steps

Building a conversation with transformative agents about the pandemic is purposefully assuming that there is something about that conversation that may help transformation itself. There still seems to be a missing link between individual experiences and organizational changes with the shift on how STI is seen, managed, promoted, discussed about. Evidence within this research

project seems to point out that some degree of SOL may have resulted from the Covid-19 pandemic and may have been apprehended through a critical reflection in which participants voluntarily participated.

Beliefs, values, assumptions (Schot et al., 2019: 26) and frames of reference (Mezirow, 1997: 5-7) changed due to the pandemic as persons were forced to prioritise their own personal and familiar situation amid the lockdown over previous daily concerns. While most people have not felt a major *life shift* occurring as such, most interviewees report *some* new understanding about life, health, home, work, and social interactions. And yet, at least three pending issues remain.

The first issue is whether SOL may be purposefully induced or not. A lack of consensus exists in the theoretical framework about whether learning simply happens or may be intentionally provoked. Trusting empirical evidence from the TIPC sample participation, the last twenty minutes of the virtual workshop were dedicated to thinking individually and sharing collectively ideas about how Second Order Learning could be fostered in our own community. Avoiding the conceptual debate for the time being, the focus of the exercise was to assume, that if it could be provoked, people may have ideas of *how* to provoke it. And they certainly did.

The following ideas intend to summarize participants' comments and proposals:

1. TIPC has a great potential to foster SOL through sharing of the experimentation which is taking place in different Global North and Global South contexts. Methodologies, techniques, learnings as well as assumptions, frames and understandings should be shared based on what has been successful and unsuccessful.

2. Another crucial point is a critical perspective on experimentation: interrogating and questioning the role, possibilities, potentials of the experimentation to address short and long term challenges and whether its specific activities are effective in challenging the assumptions and beliefs that lie behind statements or observations.

3. SOL processes require rigour, but also trust and a space where participants do not feel they will be found inadequate or wrong. Diversity of perspectives is also key in learning.

4. Finally, with regard to specific activities that TIPC can promote, participants remarked that during communication and training activities, the use of creative techniques and future imaginaries might be very useful/valuable.

The second issue is the scope of implications deriving from individuals and organisation units having had second order learning. Would that have a relevant impact on their professional development, vision, activities, responsibilities or future projects? It may be too early to tell. But we shall continue investigating with the second round of interviews, as three months have gone by since we started the process. A longer term follow-up would be ideal to put the crisis in a wider perspective.

Thirdly, while TIPC members may already be frame three and transformative innovation policy believers, when practical issues receive priority, participants tend to be outnumbered by more traditional approaches to Science, Technology and Innovation. A stronger narrative seems to be missing to support: 1) that the pandemic is unavoidably linked to human activity pushing the planetary boundaries[13], 2) the role that a plural Science, Technology and Innovation may have towards further responsibility beyond health and 3) the importance of practical involvement of other stakeholders so that the conversation moves from a specialist realm to a more open society space.

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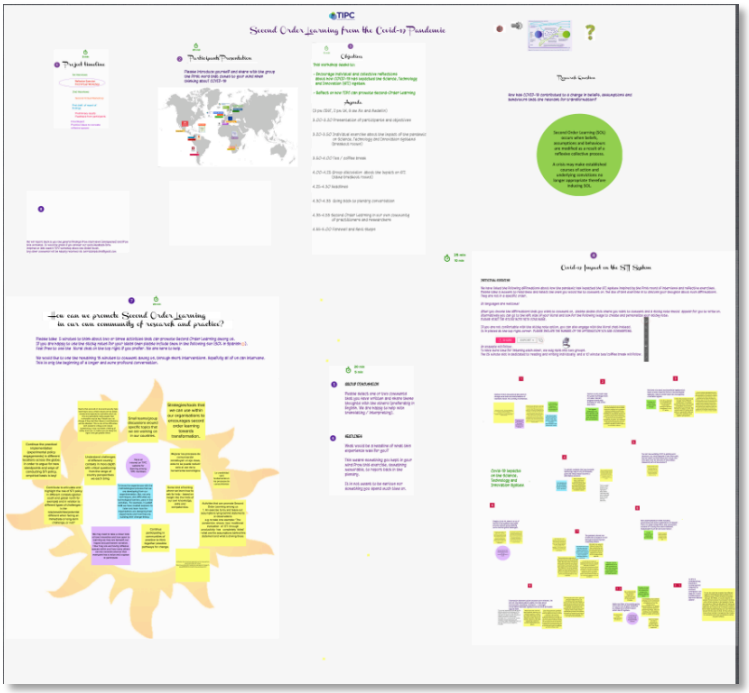
Annex 1 Questions for the First Semi structured interview

- How has Covid-19 impacted you at the following levels (what has changed)?:
  - Individual
  - Organisational
  - Social-community level
  - National
  - Global
  - Other?

- How is this pandemic affecting the STI system?
  - Is STI gaining/maintaining/losing attention as a result from COVID-19? Why?
  - Have you thought about where STI whould go after this situation? Why?

Annex 2 First Virtual Workshop Agenda

July 7, 2020 3pm-5pm CEST

Time	Activities
15:00 - 15:05	Welcome
15:05 - 15:15	Participants' presentation
15:15 - 15:20	Objectives of this workshop and Agenda
15:20 - 15:30	Introduction to the first exercise: comments on how Covid-19 has impacted STI system
15:30 - 15:55	Individual exercise, divided in two breakout rooms.
15:55 - 16:05	Break
16:05 - 16:30	Shared reflections on the first exercise. Divided in two breakout rooms.
16:30 - 16:35	Going back to plenary in main meeting room. Headlines.
16:35 - 16:55	Suggestions. How to foster Second Order Learning among TIPC participants
16:55 - 17:00	Farewell

Annex 3 First Virtual Workshop Visual Results (anonymized)