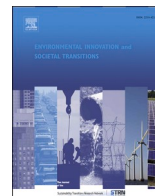


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Pathways and harbours for the translocal diffusion of sustainability innovations in Europe

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ABSTRACT

Sustainability challenges require experimenting with various types of sustainability innovations. Local and regional context conditions influence their diffusion. Our research question is: what are pathways for the transfer of sustainability innovations to other locations, and how do local and regional conditions enable this transfer? We use the notion of ‘harbours’ to conceptualise the combination of these conditions. In a comparative case study in four city-regions, analysing 48 experiments, we find that technological innovations travel easier around the globe compared to social innovations. For social innovations, the transferred knowledge has a more tacit character and the innovations are strongly embedded in the local cultural and institutional context. Signifiers may enable their translocal diffusion. Moreover, the results suggest that innovations are ‘translated’ rather than replicated. We find some important local and regional context conditions enabling transfer: cultural conditions, vibrant environments (such as festivals), networks and the presence of enabling regional actors.

1. Introduction

Sustainability transitions require local experimenting and learning with various types of sustainability innovations. Transition theory has previously explored how these innovations emerge and diffuse, and how they may challenge existing regime structures towards a system change in the longer term (Geels and Raven, 2006). Diffusion is critical for sustainability transitions to take place and is supported through various mechanisms, such as scaling up, replication, circulation and institutionalisation (Turnheim et al., 2018). In this paper we are specifically interested in replication. Replication is often conceptualised as the repetition and the reproduction of an experiment in a new context, such as a new city or country (Turnheim et al., 2018). Currently, there is still limited understanding of this ‘translocal diffusion’. The aim of our paper is to determine what mechanisms are involved in the transfer of innovations to other locations.

Previous research has demonstrated a spatially uneven pattern of experimentation (e.g. Binz et al., 2020). In Europe, city-regions such as Berlin and Barcelona are well-known hot spots (i.e. a localised high density) of sustainability experimentation (Van den Heiligenberg et al., 2018). However, city-regions in Europe also differ in the types of experiments and the processes through which these experiments emerge – ranging from experiments with social to technological innovations and from top-down to bottom-up

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governance approaches (Van den Heiligenberg et al., 2018). In the current paper, we extend this reasoning by exploring whether these hot spots differ not only in the conditions enabling experimentation, but also in the pathways enabling the translocal diffusion of these innovations.

A major challenge in the translocal diffusion of sustainability innovations is the fact that they emerge in the context of wider socio-technical systems which in turn are embedded in specific local and regional contexts. Previous research has demonstrated that it is not likely that they are directly transferable to different places (Raven et al., 2008). Due to these difficulties in translocal diffusion, we assume that it is seldom a copy-and-paste process. Although a technology may be copied to other locations, the diffusion of the whole solution (i.e. including for instance social or organisational elements) often requires a translation. Our main proposition is that this diffusion is easier when an innovation travels between similar locations, in other words locations with similar institutional, economic, political or cultural characteristics, because fewer translations and re-embeddings will then be required (Peck and Theodore, 2001). We argue that it is not so much the geographical travel distance (in km) but the similarity or dissimilarity in local and regional characteristics between the sending and receiving locations that may enable or hamper this transfer, and this is in line with the proximity concept (Boschma, 2005).

To explore the conditions enabling translocal diffusion, we introduce the harbour concept. A harbour is defined as a combination of local and regional context conditions enabling the transfer of sustainability innovations to and from other locations. Various authors give examples that this combination of conditions is important for -the transfer of- innovations; it may concern physical aspects (such as a real harbour with the combined flows of goods, money, technology and people, see Blok and Tchétschel, 2016) and/or social aspects (the combination of a hub of connections, embedded in wider networks and circulations of resource, people and knowledge, and facilitating encounters, see Torrens et al., 2019). We conclude that in the literature there is not yet a clear picture of the combination that is relevant for the transfer of sustainability innovations.

Previous literature offers various insights into distinct context conditions. In *regional innovation systems* literature, a key mechanism for innovation is knowledge transfer, which is shaped by context conditions on a regional scale, such as openness (Boschma, 2005; Simmie, 2003). However, the regional innovation systems literature primarily focuses on innovations and their market potential; as such, this body of literature generally does not address questions of transition, i.e. how transfer of innovations may contribute to system change. Current *transition research* emphasises experimentation and the ways in which innovations scale up towards regime change, but only sparsely addresses the horizontal transfer and translation of innovations into new spatial contexts (Williams, 2017). One of the few articles on this topic addresses some general context conditions for translocal diffusion, such as socio-political or cultural factors and the skills of the actors involved (Loorbach et al., 2020); however, the article does not provide any details about these factors. Hence, there is a gap in our knowledge of the transfer pathways, and in the detailed local and regional context conditions enabling this transfer. Transfer pathways concern the mechanism by which innovations diffuse translocally, including possible differences in this mechanism for the things that actually travel (for instance a technology or knowledge). It includes also the relation with local embedding.

We address the following research question: What are typical pathways for the transfer of sustainability innovations to other locations and regions, and how do local and regional context conditions enable this transfer? To capture the diversity of innovations and contexts we will compare cases from various city-regions in Europe. In this study we mainly focus on the conditions enabling transfer in the context of the experiment. However, there are indications that the internal conditions of the project may also play a role, such as the reputation and the skills of the actors involved (Loorbach et al., 2020; Torrens et al., 2019). We include project-internal conditions in this research to obtain an impression of their relative importance. In this study we will pay specific attention to the spatial scale of the context conditions. From the literature we learn that most of the conditions are present on the local and regional scales. In this study we will further analyse spatial scales.

Regarding the harbours, from the literature it is clear that a combination of local and regional context conditions is needed to facilitate the transfer of sustainability innovations, but it is not yet clear which combination this concerns. By being present together these conditions may also strengthen each other. This would be relevant information for local and regional stakeholders. In this research we will start to explore the relevance of identifying combinations of conditions enabling transfer, but with a limited number of case studies, we are not able to draw final conclusions on specific combinations of conditions.

The paper proceeds as follows. Section 2 presents our conceptual framework and provides relevant insights from various streams of the literature. Section 3 specifies the methods for finding answers to the research question. Section 4 describes the findings in four contrasting cases, and Section 5 discusses and reflects on the results. Finally, Section 6 presents our conclusions and provides some suggestions for future research.

2. Theory and conceptual framework

2.1. The building blocks of the conceptual framework

To develop a conceptual framework for the translocal diffusion of sustainability innovations, we will use both the *transition literature* as well as the *regional innovation systems literature*, because of their complementary character on the topic of translocal diffusion of sustainability innovations. In the *transition literature*, processes of experimentation and scaling-up are analysed. In the *geography of transitions literature*, the uneven spatial distribution of these experimentation processes are studied (Hansen and Coenen, 2015). However, this literature provides only little insight into the localised factors enabling this diffusion. Here, we use contributions from *regional innovation systems literature*, where knowledge transfer is studied as a key mechanism for diffusion.

Our conceptual framework has the following three building blocks: experiments, transfer pathways and harbours (see Fig. 1). For sustainability transitions to take place, innovations are tested in various types of experiments. These innovations may be transferred to

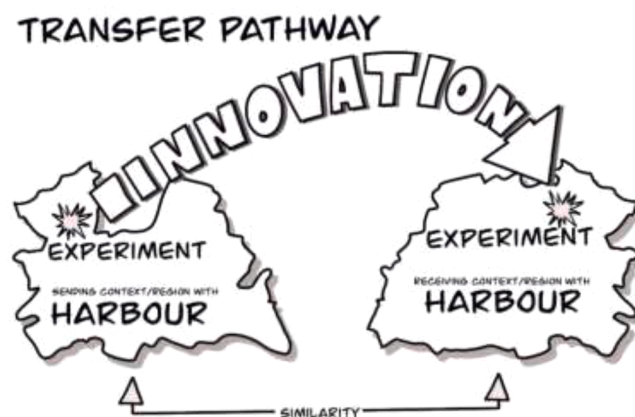


Fig. 1. Conceptual framework for the transfer of sustainability innovations.

other locations and eventually challenge the existing regime structures towards a system change in the long term. Transfer pathways conceptualise the mechanism by which innovations diffuse translocally, including possible differences in this mechanism for the things that actually travel (for instance a technology or knowledge). It includes also the relation with local embedding. This transfer of sustainability innovations may be enabled by the combination of local and regional context conditions, which we term ‘harbours’ in this article. We will now explore the three building blocks of this framework in more detail.

2.1.1. Experiments

The first building block of our conceptual framework covers the various types of experiments (i.e. the activity) in which sustainability innovations (i.e. the novelties) are tested. Our proposition is that the difference between technological and social innovations is relevant here, since it relates to the different types of knowledge used in these experiments. Experiments for technological innovation produce mainly codified knowledge [Asheim et al., 2007]. ‘Global pipelines’ may enable a diffusion process, with providers outside the local milieu [Bathelt et al., 2004]. Experiments for social innovation produce mainly tacit knowledge, the transfer of this knowledge to other regions may be problematic [Asheim et al., 2007, Bathelt et al., 2004]. The type of knowledge is relevant to this research because this may place additional requirements on the transfer pathway. This is further explained in Section 2.2.2.

We want to emphasize that this contrast between technological and social innovations has an analytical purpose. In real life we probably will meet many hybrid projects.

Another relevant dimension in types of experiments may be the distinction between top-down and bottom-up governance approaches. Van den Heiligenberg et al. (2017) suggest that guided experiments are government- or firm-initiated and grassroots experiments are civil-society- or community-initiated. Grassroots experiments may be often inward orientated, and less interested in upscaling.

2.1.2. Transfer pathways

Secondly, transfer pathways refer to the mechanism by which innovations diffuse translocally, including possible differences in this mechanism for the things that actually travel (for instance a technology or knowledge). It includes also the relation with local embedding. The mechanism of the transfer of innovations to other locations can be conceptualised in three steps: (i) a de-contextualisation, in which the context of the sending region is ‘removed’ from the innovation; (ii) the travelling of the ‘recipe’; and (iii) a re-contextualisation, in which the new context from the receiving region is added to the recipe (Williams, 2017; Turnheim et al., 2018). The form and function of the innovations thus changes as the innovations are translated and re-embedded in different institutional, economic, political and cultural contexts (Peck and Theodore, 2001; Williams, 2017). We use these conceptualisations to develop the conceptual model for this research. The model identifies objects (innovations and recipes) and transfer mechanisms, including a ‘fusion’ mechanism (see Fig. 2). The fusion mechanism refers to the combination of recipes from various innovations into a new innovation. Although the process of developing innovations by making novel combinations of product attributes is well known (Nelson and Winter, 1982), we did not find references to this fusion process in transition studies. Loorbach et al. (2020) describe a partnering process, which may be comparable to this fusion process. From the literature we may expect that for technological innovations who are “new for the region” (and not “new for the world”) this fusion process is frequently present. In this case also a “socio-technical template” will be available, which describes an acceptable way of using the innovation (Binz and Gong, 2021).

As visualised schematically in Fig. 2, a transfer pathway starts with an experiment with a sustainability innovation. The innovation is tested in a distinct location and is made context-specific by local embedding processes (Loorbach et al., 2020). This local embedding is key to the innovation’s ability to be transferred to new spatial contexts (Williams, 2017). The recipe is the part of the innovation (as a result of a de-contextualisation process) that actually travels (Turnheim et al., 2018). We understand a recipe as the generalised form of the innovation, similar to the ‘global form’ concept (Williams, 2017). Some of these recipes relate to general (often global) concepts and have distinct names, such as ‘community-supported agriculture’ or ‘repair café’. These names may act as ‘signifiers’, which are relevant to the transfer pathway because these signifiers make the recipes recognisable and findable for others who want to start a similar initiative (Loorbach et al., 2020; Silva et al., 2016). This transfer is further enabled by global platforms – for example a global

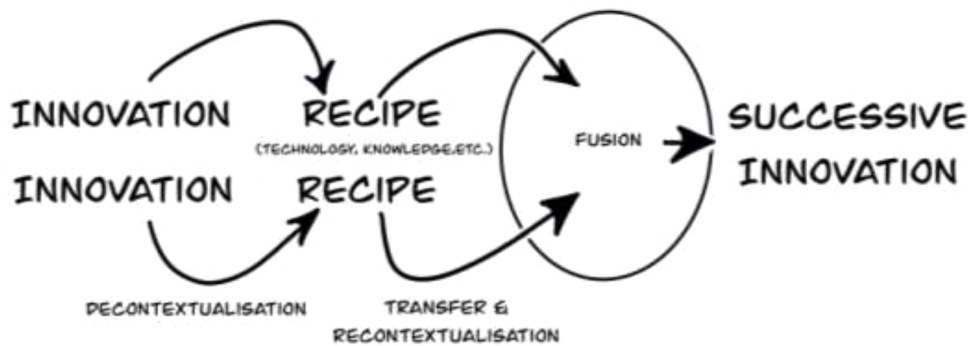


Fig. 2. The various elements of a transfer pathway.

repair café platform – where knowledge about these recipes is shared.

The recipe may have various forms; it may be knowledge, a technology, a tool, a norm or an idea (Wieczorek et al., 2015). Regarding knowledge, it is relevant to make a distinction between codified knowledge and tacit knowledge. Tacit knowledge, mostly related to social innovations, is strongly tied to the habits and norms of social groups and may therefore encounter more difficulties in its transfer than codified knowledge (Van den Heiligenberg et al., 2017). However, also technological innovations in certain sectors with a customised valuation system (where innovations are developed and tested in coproduction between producers and users) may show this local embedding in habits and norms (Binz and Truffer, 2016). We may thus suppose that social innovations (and technological innovations with a customised valuation system) need a stronger de-contextualization process for transfer. This will result in a recipe with probably a more footloose character.

The various types of knowledge involved may also influence the transfer mechanism. The transfer of tacit knowledge may require temporary proximities, such as conferences and fairs, where face-to-face contacts are possible (Bathelt et al., 2004). In these transfers of knowledge, distinct actors may play a role (see 2.2.3 Harbours).

The transfer process may lead to a new experiment with a successive innovation in another location with other characteristics. We propose that a similarity in characteristics between the sending and the receiving region facilitates a successful translocal diffusion. We found some indications of this in the literature (McCann, 2016). Similar characteristics means that fewer translations and re-embeddings are required (Peck and Theodore, 2001). The similarity concept also has an analogy with the proximity concept in the regional innovation systems literature (Boschma, 2005). From this literature, we learn that the travelling of innovations over larger distances is not problematic in itself, but may become problematic when the sending and receiving regions are dissimilar.

It is important to emphasize that the similarity concept and the harbour concept are different. The similarity concept deals with similar general institutional, economic, political or cultural characteristics. These characteristics will probably differ from the context conditions enabling the transfer of sustainability innovations.

Finally, we note that Fig. 2 is a simplification of the transfer process in the real world. The transfer mechanism is probably not a linear process, but will show more bifurcations (senders sending knowledge to multiple receivers) and fusions (receivers receiving knowledge from multiple senders).

2.1.3. Harbours

The third building block in our conceptual framework is the harbour, which refers to the combination of local and regional context conditions that enable the transfer of sustainability innovations to and from other locations. In the model, we suggest that sending as well as receiving regions may have a harbour, i.e. a capacity to export or import innovations. The absence of -a combination of- local and regional context conditions may hamper this capacity. For the harbour concept we build on previous contributions on harbour and port concepts shaping the transfer of innovations, including Torrens et al. (2019), Ong (2011), Blok and Tschötschel (2016), Simmie (2003), Boschma (2005) and Beck et al. (2013).¹ Some authors explicitly refer to the importance of having a combination of context

¹ The harbour concept presented here resonates strongly with the literature review by Torrens and colleagues (Torrens et al., 2019). They present three metaphors for sustainability experimentation: the seedbeds, the harbours and the battlegrounds. They characterise the harbour metaphor as a space of exposure and encounter, offering a receptive context for ideas and facilitating the mobility of best practices. A theoretical foundation for the harbour concept is formed by the moorings/mobilities dialectic. Urry argues that “there can be no movement without context, without something to push off from” (Urry, 2003). The literature indicates that a harbour is often manifest on the scale of a city-region (Blok and Tschötschel, 2016; Simmie, 2003). A general assumption in the literature is that the diffusion of innovations is enabled by openness, meaning more access to the outside world (Boschma, 2005). In this research we use the harbour concept in a figurative sense, although also in a literal sense harbour cities may possess many of the conditions enabling transfer. In our view this has probably little to do with the function of an actual harbour from which innovations are shipped. Blok and Tschötschel (2016) show that harbour cities, because of their long-term international orientation, can be an assemblage point for local and transnational ideas. These cities may show a ‘cosmopolitan community’, potentially enabling collective action, cosmopolitical decision-making and international norm generation (Beck et al., 2013). We argue that the conditions enabling the transfer of innovations may also be available in cities and regions that do not host an actual harbour.

conditions enabling -the transfer of- innovations. [Torrens et al. \(2019\)](#) refers to the combination of a hub of connections, embedded in wider networks and circulations of resource, people and knowledge, and facilitating encounters. [Blok and Tchötschel \(2016\)](#) mention a real harbour with the combined flows of goods, money, technology and people. [Ong \(2011\)](#) mentions the city as a particular nexus of situated and transnational ideas, institutions, actors, and practices that may be variously drawn together for solving particular problems.

Moreover, we executed a thorough review of the literature. We intentionally searched with a broad scope, to justify for the various bodies of literature and for the various concepts used in research on the transfer of innovations.²

We expect the following categories of local and regional context conditions to be particularly relevant.

Local and regional cultural conditions. Cultural conditions cover the general values, norms and attitudes of actors; they may be localised on the local or regional scale. Institutional adaptations, such as a change in norms, values and beliefs, may stimulate diffusion ([Van Waes et al., 2018](#)). A general attitude of openness towards new ideas may enable the exchange of knowledge needed for translocal diffusion ([Capdevila, 2018](#)). Furthermore, the place-reputation is important for the adoption of knowledge and ideas by others ([Sengers and Raven, 2015](#); [Torrens et al., 2019](#)).

Local and regional networks. Networks are broad and diverse social circles between related actors. In the innovation literature, they are considered important enablers of innovations and their diffusion ([Powell and Grodal, 2009](#)). In this way, networks are closely related to the transfer pathway (see Section 2.2.2). In the regional innovation systems literature, it is emphasised that a firm's membership of a network facilitates the transfer of knowledge. Networks are relevant on the local as well as on the global³ level ([Trippel et al., 2009](#)).

Local and regional vibrant environments. Vibrant environments may relate to greater diffusion success ([Seyfang and Longhurst, 2016](#)). In this study, we use such environments to indicate various forms of spaces and meeting places. These spaces and places enable interaction between actors, and they are conceptualised as temporary proximities such as conferences and fairs, also inspired by the 'local buzz' concept in regional innovation systems literature. Buzz refers to the information and communication ecology created by face-to-face contacts within the same place or region ([Bathelt et al., 2004](#)). These face-to-face contacts may be relevant for the transfer of innovations to other locations. Hubs, conceptualised as locations that have a high physical connectivity, such as airports, seaports and brainports, may relate to these vibrant environments and may enable a transfer of innovations ([Conventz et al., 2016](#)).

Local and regional enabling actors. Various actors in the regional context of the experiment may influence the transfer of innovations in a positive way. This category is a broad category, encompassing various actors, actor groups and their activities. These actors include local and regional governments, universities and intermediaries, and they are involved in vision development, knowledge exchange and learning processes (e.g. by highlighting examples of good initiatives supported by for instance media attention), in funding and in creating a room for experimentation, enabling the (future) translocal diffusion of innovation ([Kauffeld-Monz and Fritsch, 2013](#); [Matschoss and Heiskanen, 2017](#); [Van den Heiligenberg et al., 2017](#)).

Table 1 presents a detailed overview of the local and regional context conditions found in the literature. This overview contains a large diversity of factors; we will empirically determine the most important ones.

3. Methodology

Our research question requires an analysis of the transfer pathways of sustainability innovations tested in experiments, and of the local and regional conditions enabling this transfer. For practical reasons we chose to focus on the enabling conditions on the sending side. Based on existing literature, we presume that these pathways vary considerably between the various types of experiments. For this reason, and in line with the explorative nature of the research topic, we chose for a comparative qualitative case study ([Bryman, 2012](#)). This allows us to analyse the contrast between various types of experiments regarding transfer pathways (for the local and regional context conditions we have only little indication from the literature that there is contrast between the various types of experiments). Building on earlier research ([Van den Heiligenberg et al., 2018](#)), we selected four city-regions in Europe to capture a diversity of experiments. New data were collected for this study to enable characterisation of the transfer pathways and the local and regional context conditions.

For each city-region, we selected appropriate projects and interviewed the project leaders. Projects were selected based on the

² We systematically searched for articles citing one or more early well-known key articles on the upscaling of sustainability experiments (in the transitions literature) and on the spatial diffusion of innovations (in the regional innovation systems literature). The key articles are: ([Bulkeley and Castán Broto, 2013](#); [Smith and Raven, 2012](#); [Coenen et al. 2012](#); [Bathelt et al. 2012](#); [Maskell and Malmberg, 1999](#)). This resulted in a list of over 1700 articles. From this list we selected empirical articles mentioning localised context conditions enabling replication, diffusion, upscaling or transfer of innovations, and we added a few important additional references to the technological innovation systems literature. The resulting list of about 30 articles was used for the Theory Section.

³ Regarding global networks, we are especially interested in the network membership by a regional actor, who may have a distinct role in transferring and translating knowledge from outside into the local and regional milieu, as described by [Bathelt et al. \(2004\)](#). Whether this membership is of a regional or global scale is debatable. Here, we consider the global network as having a global scale, and the membership of this network by a regional actor as having a local/regional scale.

criterion that they were characteristic of the distinct type of activity for the case, as described in Fig. 3. A second criterion was that the projects should have an experimental character: i.e. a prototype is available, it may have been tested a few times, but there is still uncertainty whether it will work in real life and whether it will be embedded in the regime. A third selection criterion was that there should be evidence of attempts to bring the innovation to a successive experiment elsewhere, and this was verified in the interviews. We consider these experiments as ‘sending’ experiments, leading to successive experiments in another location. In the interview with the sender, we identified the ‘receiving’ experiment. To obtain a reliable picture of what had been transferred as well as to gain information about whether the innovation was actually used, we also conducted an interview with the project leader of the receiving experiment. The main steps in our research were (i) case selection, (ii) data collection (developing the questionnaire and executing the interviews), and (iii) data analysis to find the answers to the research question.

3.1. Case selection

As explained above, we used the cases from earlier research to cover a large variety of sustainability experiments. The cases show contrast along two dimensions: the type of knowledge used in the experiments and the type of governance in the experiments. Fig. 3 presents the four cases, which are four distinct types of experimentation in various city-regions in Europe.

3.2. Data collection

We developed interview questions for semi-structured interviews. The questions dealt with the innovation that was tested in the experiment, with what was transferred to a successive experiment and how this was transferred, with the location of the receiving experiment, and with the general and local/regional conditions that promoted this transfer. A detailed overview of the interview questions can be found in Appendix A.

The interviews were conducted in two rounds. In the first round, in each of the four city-regions we interviewed the project leaders of six ‘sending’ sustainability experiments (a total of 24 interviews). In the interview with the senders, we asked them to identify a ‘receiving’ experiment. Subsequently, a second round of interviews was planned with the project leaders of the 24 receiving

Table 1
Detailed overview of local and regional context conditions found in the literature.

category	local and regional context conditions
local & regional cultural conditions	<ul style="list-style-type: none"> • institutional adaptations (Van Waes et al., 2018) • culture of openness and an open-source mentality (Lawson and Lorenz, 1999; Capdevila, 2018; Van den Heiligenberg, 2018) • place-reputations (Sengers and Raven, 2015; Torrens et al., 2019) • reputation of local actors (Torrens et al., 2019)
local & regional networks	<ul style="list-style-type: none"> • interpersonal social networks (Huang et al., 2018b) • networks with users and producers (Lawson and Lorenz, 1999). • a firm’s membership of a local/global network (Tripl et al., 2009). • regional networks and regional platforms (Noseleit, 2018) • membership of transition clubs and global city networks (Noseleit, 2018; Williams, 2017) • virtual knowledge communities (Tripl et al., 2009) • membership of global platforms (Capdevila, 2018)
local & regional vibrant environments	<ul style="list-style-type: none"> • temporary proximities, e.g. conferences, fairs, fair trade fairs (Bathelt et al., 2004; Feola and Butt, 2017). • geographical proximity of firms and clusters (Kaygalak and Reid, 2016) • geographical proximity of pioneers and followers (Huang et al., 2018a). • hubs, e.g. airports, seaports and brainports (Conventz et al., 2016). • knowledge hub (Ciapetti and Perulli, 2018).
local & regional enabling actors	<ul style="list-style-type: none"> • global intelligence corps (Torrens et al., 2019; Williams, 2017), traders (Sjöholm, 1996), travelling bureaucrats (Torrens et al., 2019) and intermediaries such as consultants and employees of NGOs (Carvalho and Lazzarini, 2018; Inkinen and Suorsa, 2010; Matschoss and Heiskanen, 2017) • local and regional government by developing vision/policies (Schwanen, 2015), by enabling local and adaptive learning and networking (Giest, 2017; Karanasios and Parker, 2018; Andersson et al., 2018), by giving funding (Surana and Anadon, 2015; Schwanen, 2015), by realising institutional adaptations (Van Waes et al., 2018), by highlighting examples of good initiatives (Van den Heiligenberg et al., 2018) and by providing a room for experimentation (Van den Heiligenberg et al., 2017) • educated workforce and their spatial mobility enabling diffusion of knowledge (Bento and Fontes, 2015; Fitjar and Rodríguez-Pose, 2015; Miguélez and Moreno, 2013) • workforces engaging with informal networks enabling diffusion (Herstad and Ebersberger, 2015). • universities as gatekeepers enabling diffusion of knowledge (Kauffeld-Monz and Fritsch, 2013). • civil society, by transferring narratives (David and Schönborn, 2018). • leaders on the project level and movement level, e.g. by presenting their project to others (Boyer, 2018; Feola and Nunes, 2014). • Market formation by regional actors (Rohe, 2020)

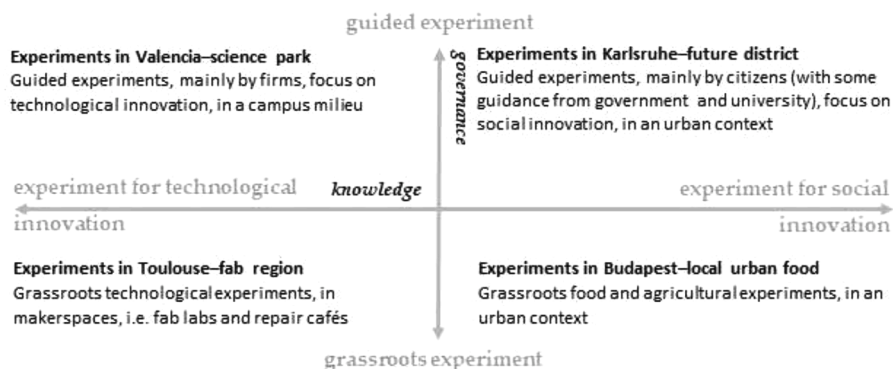


Fig. 3. The selected cases (adapted from Van den Heiligenberg et al., 2017). The axes in the figure have an analytical purpose. In real life the experiments will show mixed characteristics.

experiments. A detailed list of the interviews can be found in Appendix A. Unfortunately, some of the interviews with the project leaders of receiving experiments could not take place. There were two reasons for this. First, in four cases we were unable to contact the receiver. Second, in three cases the sender was not willing to identify the receiver for reasons of confidentiality, in other words to protect the innovation or the partnership. This is also indicated in Appendix A. The interviews were conducted by telephone and lasted 30–45 min; they were carried out by the researcher and an assistant in 2019–2020, based on a number of pilot interviews in 2017.

3.3. Data analysis

We analysed the interviews and reported the findings for each city-region along the three building blocks of our conceptual framework (see also Table 2):

- Experiments: a description of the type of innovation which was tested in the sending and receiving experiment.
- Transfer pathways: an analysis of (i) what was transferred (including a comparison of the statements about what was transferred between senders and receivers); (ii) the mechanisms of transfer (including how it was transferred, the use of recipes, as well as de-contextualisation and re-contextualisation processes, in relation to embedding and fusion processes), and (iii) the similarities between sending and receiving regions (including the spatial pattern of transfers to other locations). It was not possible to question the similarities directly; for this topic, we made a comparison of the sending and receiving region, interpreting statements from the interviewees.
- Localised context conditions enabling transfer and harbour: an analysis of the local and regional context conditions that enable transfer, including an analysis whether they are enabling transfer in combination (harbour). The statements from the respondents in the interviews allowed us to analyse the spatial scale of the context conditions. Since we are also interested in the project-internal conditions (see Introduction section), we reported them separately.

The statements of the interviewees were validated by using triangulation, i.e. by comparing their statements with statements from other interviewees in the same city-region, by comparing the statements from sender and receiver, and by comparing with empirical findings from earlier research in these city-regions.

Finally, we compared the cases on the transfer pathways and the context conditions (including their combination in a harbour), also using the two propositions formulated in the Theory section: (i) *Experiments for social and technological innovation will have different transfer pathways* and (ii) *A similarity in characteristics in the sending and the receiving regions facilitates a successful translocal diffusion*.

4. Findings

4.1. Budapest – local urban food

4.1.1. Experiments

In the Budapest region, many grassroots food initiatives have been started in the past few years that focus on supplying sustainable food in an urban context. We analysed grassroots food experiments and initiatives as well as their transfer to other locations. Five of the six ‘sending’ experiments covered mainly social innovations (see Table 3).

4.1.2. Transfer pathways

The experiments mostly transfer practical knowledge. The local food innovations and the practical knowledge involved are strongly embedded in the history of Hungary and in the widespread traditional ‘kitchen garden’ practice (Balasz et al. 2018, n.d.). This may hamper the translocal diffusion of innovations to other countries.

Table 2

How the interview questions are related to the dimensions in the case study findings.

Dimension in case study findings	Related interview questions (the letters refer to the questions as described in Appendix A)	
Experiments	1a	Description of sending experiment
	2a	Description of receiving experiment
Transfer pathways	1b	Possibility of transfer
	1c	What was transferred and how
	1d	Location of successive experiment
	2b	What was received
Localised context conditions enabling transfer and harbour	1e	Conditions enabling transfer (sender)
	1f	Local/regional conditions for transfer
	2c	Conditions enabling transfer (receiver)

Whereas the senders often showed a strongly idealistic sustainability ambition and a wish to transfer these ideals to others, the receivers sometimes had a more practical attitude; they were interested in the implementation of the innovations in daily practice. This implementation in daily practice may also signal an embedding process. In this transfer of mainly tacit knowledge, the geographical proximity between sender and receiver is important; knowledge transfer between sender and receiver is carried out via bilateral face-to-face contact and in network meetings in the city.

In three of the six Budapest sending experiments, a signifier was used (i.e. a distinct name concerning a general concept). One of these is the Community Supported Agriculture recipe; this is a global concept for a localised food system. Globally, this recipe is known as ‘CSA’, and in Hungary it has a distinct name (*Szatyor Bolt*) and distinct characteristics. This indicates a contextualisation to the Hungarian situation. A pioneer started this system in Budapest around 2007 and stated, “The name of our initiative is now used in other cities, on TV and at the Ministry. Our initiative was succeeded by 30–40 similar initiatives; however, the solution has not been copied” [interview no. 1.5]. This again implies a de-contextualisation and re-contextualisation mechanism within Hungary. Only one sending experiment was transferred unaltered (replicated); this was a special case, where a food bank started a subsidiary in another city.

Five of the six analysed innovations travelled within the city of Budapest to a location with a similar cultural and political context as the sending location. Within the city, interviewees indicated that innovations travel even more easily within a specific district, to locations with a similar countercultural milieu and with similar political characteristics. As one interviewee stated, “Our district is supportive to the transfer of innovations. There is a strong community feeling, a progressive civil society and a vibrant environment. It is an enclave in a defensive regime context” [interview no. 1.11]. Travelling of innovations may thus be very much contained by these similarities.

4.1.3. Localised context conditions enabling transfer and harbour

The urban food counterculture in Budapest is a group of urban, open-minded and often young people. In the context of the experiments, the cultural conditions in Budapest are of key importance to enabling the transfer of innovations. Interviewees mostly indicated that these conditions (such as trust, openness and a sustainability ambition) are localised within the food subculture in the city, or even within a particular district [interviews nos. 1.1, 1.2, 1.3, 1.8 and 1.10]. This subculture has strong shared values regarding sustainable food, such as food should be healthy, zero-waste and solidary (Van den Heiligenberg et al., 2018). Three interviewees mentioned that the transfer of knowledge takes place in vibrant environments such as festivals, where the subculture meets. Local food networks support this transfer.

Budapest has a distinct food and transportation hub function in the country. This is a condition especially important for the food banks, since they are reliant on food flows. It is unclear whether this hub function also influences the transfer of innovations.

Half (50%) of the interviewees identified the skills of the people as a condition that enables transfer. We asked in more detail to what extent these skills were necessary. Since these skills were identified as related to the senders and receivers rather than to the general environment, we do not classify these skills as a context factor, but as a project-internal factor.

4.2. Karlsruhe – future district

4.2.1. Experiments

In the Karlsruhe region, many small-scale sustainability experiments are carried out, organised by social entrepreneurs or citizens, with some guidance and support from the government and the university. We analysed experiments and initiatives from this group of experiments, including their transfer to other locations; they cover mainly social innovations and use not only tacit but also codifiable knowledge (see Table 4).

Karlsruhe is a city-region in which many new sustainability initiatives and experiments have been emerging. In earlier research, Karlsruhe has been identified as a ‘mature habitat’ for experimentation (Van den Heiligenberg et al., 2018). In this research we found not only that many experiments emerge in this city-region, but also that many disappear or are transferred.

4.2.2. Transfer pathways

Between successive experiments, there is a transfer of mainly practical know-how and experiences. In two cases an administrative tool was also transferred.

Table 3
Overview of the findings in the Budapest – local urban food case.

sending experiment(all located in Budapest)	receiving experiment and location	transfer pathway: what was transferred?	transfer pathway: how was it transferred?	localised context conditions
green walls: indoor modular system for growing herbs and microweeds	vertical gardens (Budapest)	<ul style="list-style-type: none"> • practical experience • the reasons behind it* 	<ul style="list-style-type: none"> • face-to-face meetings, workshops 	<ul style="list-style-type: none"> • open-source mentality • international openness • trust and openness • local and national networks
responsible gastronomy: certificates for sustainable restaurants	sustainable cooking in restaurants (Budapest)	<ul style="list-style-type: none"> • practical knowledge; ‘how to do it’* 	<ul style="list-style-type: none"> • contact on network meeting 	<ul style="list-style-type: none"> • shared sustainability ambition • open-source mentality • local network • educational attainment
local food system: buying food from organic farmers nearby and selling it in the city	local food shop: buying food from organic farmers nearby and selling it in the city (Budapest)	<ul style="list-style-type: none"> • part of solution • tool* • ideas • inspiration 	<ul style="list-style-type: none"> • bilateral face-to-face contact • network meetings 	<ul style="list-style-type: none"> • shared sustainability ambition • trust • openness • local network
food bank: taking food surpluses to poor people	food bank: taking food surpluses to poor people (Hajdú-Bihar, Hungary)	<ul style="list-style-type: none"> • complete solution • practical knowledge* 	<ul style="list-style-type: none"> • bilateral face-to-face contact 	<ul style="list-style-type: none"> • community in city • trust • friendliness • food network • food and transportation hub
community gardens: growing food with community groups	community garden: growing food with community groups (Budapest)	<ul style="list-style-type: none"> • practical knowledge 	<ul style="list-style-type: none"> • bilateral face-to-face contact • contact on network meetings • internet 	<ul style="list-style-type: none"> • shared sustainability ambition • openness and open-mindedness • subculture in district • festivals • support from government • support from university
food packaging; application of re-usable plastic cups on food festival	food packaging; application of re-usable plastic cups on event (Budapest)	<ul style="list-style-type: none"> • practical knowledge; ‘how to do it’ • the reasons behind it* • how to communicate* 	<ul style="list-style-type: none"> • not mentioned 	<ul style="list-style-type: none"> • shared sustainability ambition • vibrant environment • festivals • support from government • support from international NGO

* This information on what was transferred was mentioned by the sender or receiver only, and not confirmed by their counterpart.

The transfer takes place mostly in bilateral and network meetings. In four of the six sending experiments, a signifier was used (i.e. a distinct name concerning a general concept). The signifiers were used for the sending as well as the receiving innovation, such as a *Quartiersprojekt* (a district project) and a *Leihladen* (a rental shop). The names of these recipes are well-known in Germany; this facilitates the diffusion of these innovations. As stated by [Loorbach et al. \(2020\)](#), “Individuals pick up ideas from the media and start a similar initiative”. However, these innovations were not replicated or imitated (i.e. transferred unaltered); de-contextualisation and re-contextualisation took place and only a part of the experiment solution was copied.

Receivers indicated that they not only used the innovation received from the identified sender, but also used various other sources for developing their innovation (mostly two to five sources). The resulting experimental solution was mostly a fusion of various parts from various senders. This fusion process sometimes goes hand in hand with a growing professionalism.

Table 4
Overview of the findings in the Karlsruhe – future district case.

sending experiment(all located in Karlsruhe)	receiving experiment and location	transfer pathway: what was transferred?	transfer pathway: how localised context was it transferred?	conditions
project on beekeeping: community gardening and beekeeping & connecting to the soul	urban gardening project (Karlsruhe)	<ul style="list-style-type: none"> • practical knowledge • codifiable knowledge* 	<ul style="list-style-type: none"> • contact on network meeting • face-to-face contact on festivals • email 	<ul style="list-style-type: none"> • trust and openness • vibrant environment • festivals • network meetings • hub for transfer
project on creative workshops: contributing to community building	project on district activities: organising creative activities, lectures and meetings (Karlsruhe)	<ul style="list-style-type: none"> • formula* • general ideas* • experiences* 	<ul style="list-style-type: none"> • bilateral face-to-face contact • network meeting 	<ul style="list-style-type: none"> • trust and openness • creative culture • cooperative culture • regional conferences • network meeting • support from local government • support from university
project on renting cargo bikes for free	cargo bikes (Karlsruhe)	<ul style="list-style-type: none"> • information* • experience* • tool* 	<ul style="list-style-type: none"> • bilateral face-to-face contact • media 	<ul style="list-style-type: none"> • shared sustainability ambition • sustainability subculture • intercity network • festivals
sustainable clothing for children: producing and selling sustainable, fair-trade and locally produced clothing	renting clothing for children: renting clothing with sustainable criteria (Halle, Germany)	<ul style="list-style-type: none"> • know-how on producing* • criteria for products* 	<ul style="list-style-type: none"> • bilateral face-to-face contact • internet 	<ul style="list-style-type: none"> • trust • trade fair • support local government
borrowing shop for free: renting household devices	borrowing shop for free: renting tools, instruments and toys (Stuttgart, Germany)	<ul style="list-style-type: none"> • codifiable knowledge 	<ul style="list-style-type: none"> • phone 	<ul style="list-style-type: none"> • openness • vibrant environment • global network • support from university
first shop on borrowing electronic devices for free: renting tools and devices	second shop on borrowing electronic devices for free: renting tools and devices (Karlsruhe)	<ul style="list-style-type: none"> • practical experience (know-how on doing it) • ideas • tools 	<ul style="list-style-type: none"> • contact on meeting • contact on festival • transport 	<ul style="list-style-type: none"> • shared sustainability ambition • festivals

* This information on what was transferred was mentioned by the sender or receiver only, and not confirmed by their counterpart.

Successive experiments have emerged in other districts in Karlsruhe, and this indicates an embedding of the sending experiments in the political and cultural context. Moreover, experiments have been transferred to other medium-sized cities in Germany, i.e. Stuttgart and Halle. Previous experiments in Berlin were often mentioned as important pioneers, and these acted as sources of inspiration.

4.2.3. Localised context conditions enabling transfer and harbour

The pioneers in Karlsruhe are part of a supportive general regional culture; several interviewees emphasised the mindset in the region Baden-Württemberg. Elements of this culture include a liberal, open-minded, pragmatic and mutually supportive attitude.

The most important enabling context conditions for transfer are vibrant environments, cultural conditions and network membership. In Karlsruhe, festivals and fairs are important vibrant environments. Maskell et al. (2006) describe how conferences and fairs act as temporary proximities and meeting places for business people, at which a transfer of knowledge and ideas takes place. Festivals may have the same role for sustainability innovations. As one of the interviewees stated, “Festivals are very important for me. I meet the important stakeholders there. The diversity of the network is essential, and also the shared sustainability values of the network members” [interview no. 2.11].

The most important cultural conditions for transfer are formed by trust and by a shared sustainability ambition. One of the interviewees formulated the importance of a shared ambition quite clearly: “We are members of a new subculture with a new lifestyle; we have a task in helping other communities to do the same” [interview no. 2.5]. The local networks are especially important for knowledge transfer in the city. These network meetings are organised by the local government and by the university. They support the citizen groups by providing infrastructure, a meeting place, an existing network, public relations, funding and legitimisation.

An important non-localised condition in this case is publicity for the experiments. We regard publicity as a non-localised condition since it does not necessarily vary across space.

4.3. Valencia – science park

4.3.1. Experiments

In the Valencia region, many sustainability experiments with technological innovations are carried out, for instance in food (e.g. biological agriculture), energy (e.g. ICT and technology), mobility (e.g. electric vehicles), circular economy (e.g. plastics) and water (e.g. saving water). We analysed technological innovations in firms, mostly start-ups, and the transfer of these innovations to other companies. The experiments often use codifiable knowledge and are often located in a ‘science park’ environment with a strong university-industry relation (see Table 5).

4.3.2. Transfer pathways

The majority of firms use highly specialised technological knowledge. This knowledge is transferred to firms in the same sector, mostly in meetings. The transfer of this knowledge requires face-to-face contact.

Replication did not occur; every firm developed its own unique innovation, based on the global and regional circulation of expert knowledge in dedicated networks and via international project cooperation.

We did not observe a strong embedding of the innovations in the local cultural or institutional context of Valencia. Therefore, de-contextualisation and re-contextualisation processes were not strong. The only exception was an innovation on preventing food waste,

Table 5

Overview of the findings in the Valencia – science park case.

sending experiment(all located in Valencia)	receiving experiment and location	transfer pathway: what was transferred?	transfer pathway: how was it transferred?	localised context conditions
firm on water-saving technology	R&D firm (in different country)	knowledge about technology* knowledge about tests*	• workshops	• regional openness • vibrant environment • regional networks • regional specialisation
start-up firm on solar energy for industrial processes	firm on solar energy for industrial processes (Freiburg, Germany)	ideas and insights* practical knowledge* knowledge about technology* customer information*	• email/phone • personal visit	• international meetings • regional/national/EU funding
start-up firm on car sharing for daily travel	competitor on car sharing (Paris, France)	technological information* customer information*	• contact on international fairs	• openness • international events and fairs • university and students
firm on energy-efficient heating with microwave technology	firm on energy-efficient heating with microwave technology (university city, The Netherlands)	device knowledge about technology*	• meetings	• trust • collaborative space • local network • global sustainability network • universities
start-up firm on using ICT to prevent food waste	start-up firm (social enterprise) on food donations and food waste (Castellon, Spain)	technological information customer information	• meeting	• shared sustainability ambition • meetings, fairs and conferences • co-working space • stakeholder networks
start-up firm on CO ₂ reduction protocol	association of firms in industrial area (Valencia, Spain)	protocol knowledge advice*	• training	• start-up association • open-mindedness • shared sustainability ambition • local conferences

* This information on what was transferred was mentioned by the sender or receiver only, and not confirmed by their counterpart.

which may be embedded in local practice and which was transferred to a city nearby.

Most of the interviewees wanted to protect their innovation. They patented their innovation and some had a non-disclosure agreement with their major partners. In the interviews, three firms did not wish to identify their main partners. This high level of protection and confidentiality may hamper the diffusion of innovations (although patents may also encourage diffusion under certain conditions, see [OECD \(2004\)](#)). Some interviewees were aware of this possible tension. As one interviewee stated, “Now that I know more about saving the planet, I am more open to sharing my technological knowledge” [interview no. 3.3]. The firms not only used the innovation from the identified sender, but used various sources, such as other firms, universities, research companies and local governments, for developing their innovation in a fusion process.

Transfer took place to firms in other university regions in Spain and in other European countries. The receiving regions show economic similarities to Valencia: they are all knowledge-intensive university cities. It is not a one-way transfer; almost all of the interviewees indicated that the transfer is part of an interactive circulation of knowledge.

4.3.3. Localised context conditions enabling transfer and harbour

For transfer of innovations, the vibrant environment of the Valencia city-region is of eminent importance. Firms build networks, and they exchange information and knowledge in a large variety of meetings, conferences, fairs and co-working spaces. Festivals are not important; one interviewee stated that “the visitors of festivals are not interested in innovations” [interview no. 3.9]. In addition, the importance of networks was mentioned in 50% of the interviews. Various regional networks are important, including expert networks, start-up networks and multi-stakeholder networks; in addition, one interviewee indicated that he transferred knowledge in specialised expert networks on a global scale [interview 3.7].

A number of cultural conditions were considered important enablers, especially regional openness and a shared sustainability ambition in the region. Openness may be at odds with the wish to protect the innovation. As one interviewee indicated, “We have to be open, but at the same time we have to be careful and cautious” [interview no. 3.5].

The universities in Valencia are important regional enabling actors. They transfer knowledge, they organise conferences and they have students who are interested in acting in a pioneer user group for testing innovations.

A few interviewees mentioned the importance of media attention for the transfer of innovations, which is a non-localised condition [interviews nos. 3.9 and 3.10].

4.4. Toulouse – fab region

4.4.1. Experiments

In the Toulouse region, many grassroots experiments with technological innovations are carried out, for instance in approximately 35 fab labs, about 15 repair cafés, a hacker space, ICT associations and electronics associations. We analysed the innovations developed by a few ‘makers’ in fab labs and by people in repair cafés, and their transfer towards successive experiments. The fab lab innovations mostly use codifiable knowledge or actual computer code (see [Table 6](#)).

4.4.2. Transfer pathways

In the makerspaces of Toulouse there is a focus on the transfer of codifiable technological knowledge on ‘how to make it’. Furthermore, there is a transfer of best practices and tools. Even this codifiable knowledge required face-to-face contact for transfer.

Although there is a strong open-source mentality in the community, the transfer of innovations in fab labs was often problematic. Replication did not take place and recipes were not used: “Everyone is trying to develop their own version of the same thing” [interview no. 4.5]. In the fab labs we noticed an atmosphere of creativity and self-expression, but no interest in diffusion.

In the repair cafés, there was more attention to the transfer of the ‘whole solution’, including social and organisational elements. Still, replication did not occur, which indicates a re-contextualisation process. In the region, the generalised global recipe of the repair café has a distinct name (*Café Bricol*), although there has been some discussion about using the global or the regional name. As one interviewee stated, “I wanted to use the same name, but it was not possible” [interview no. 4.12]. This transfer takes place in face-to-face contact. In the discussions, attention was paid to the value of becoming a member of the transition movement. The approach has been very successful; the growth of the number of repair cafés is remarkable. At this moment, more than 15 repair cafés have been established in the region, and some volunteers now earn a salary from them.

The global fab lab community has a strong open-source and sharing culture, and most labs are members of a strong global network with strong similar institutional characteristics (most fab labs have signed the ‘fab lab charter’). These similar characteristics could enable a global transfer of innovations between labs. However, the innovations that we analysed were mostly transferred to nearby locations in the same city. Another possible pathway for the transfer of fab lab innovations is the pathway to incubators and firms. However, earlier research observed that this route is problematic ([Van den Heiligenberg et al., 2018](#)). There was one successful example; this was a maker who ‘transferred’ himself and started his own company.

Repair cafés transferred their solutions to other similar locations nearby, within the city or to another city in the region. Compared to fab lab innovations, the repair café solutions were probably more embedded in the local cultural and institutional context. This may hamper the transfer over larger distances to locations with non-similar characteristics.

4.4.3. Localised context conditions enabling transfer and harbour

interviewees emphasised a dominant role of festivals for the transfer of innovations [interviews nos. 4.1, 4.2, 4.5, 4.6, 4.7, 4.11 and 4.12]. Members of a countercultural movement in Toulouse meet at a yearly festival, which has about 35,000 participants ([Van den](#)

Table 6
Overview of the findings in the Toulouse – fab region case.

sending experiment(all located in Toulouse)	receiving experiment and location	transfer pathway: what was transferred?	transfer pathway: how was it transferred?	localised context conditions
creative prototype at fab lab	innovation at incubator (Mumbai, India)	<ul style="list-style-type: none"> • documentation* • computer code* • ideas* 	<ul style="list-style-type: none"> • email • contact on festival 	<ul style="list-style-type: none"> • open-source mentality • shared sustainability ambition • global network • open-source mentality • shared sustainability ambition • community meetings • conference • skilled people • open-source mentality • festivals • conferences • regional network • local government • social/cognitive proximity • festival
energy prototype at fab lab	part of energy prototype (Toulouse)	<ul style="list-style-type: none"> • knowledge about technology • equipment* 	<ul style="list-style-type: none"> • bilateral face-to-face contact 	<ul style="list-style-type: none"> • open-source mentality • shared sustainability ambition • community meetings • conference • skilled people • open-source mentality • festivals • conferences • regional network • local government • social/cognitive proximity • festival
biotechnology prototype at fab lab	start-up firm on biotechnology (Toulouse, France)	<ul style="list-style-type: none"> • prototype 	<ul style="list-style-type: none"> • carried by person 	<ul style="list-style-type: none"> • open-source mentality • festivals • conferences • regional network • local government • social/cognitive proximity • festival
fab lab innovations	fab lab innovations (Naples, Italy)	<ul style="list-style-type: none"> • knowledge* • best practises* 	<ul style="list-style-type: none"> • international project 	<ul style="list-style-type: none"> • open-source mentality • festivals • conferences • regional network • local government • social/cognitive proximity • festival
repair café for bikes	repair café (Albi, France)	<ul style="list-style-type: none"> • practical experience (know how to do it) • tools 	<ul style="list-style-type: none"> • carried by person 	<ul style="list-style-type: none"> • open-source mentality • festivals • conferences • regional network • local government • social/cognitive proximity • festival
repair café	repair café (Toulouse region)	<ul style="list-style-type: none"> • major part of solution • principles* 	<ul style="list-style-type: none"> • bilateral face-to-face contact 	<ul style="list-style-type: none"> • openness • shared sustainability ambition • festivals • local/regional networks

* This information on what was transferred was mentioned by the sender or receiver only, and not confirmed by their counterpart.

Heiligenberg et al., 2018). The global fab lab community organises a yearly festival, which was held in Toulouse in 2018. In addition, smaller festivals, community meetings and conferences are organised in the city and the region. These festivals may act as temporary proximities, where like-minded people from the same community meet, discuss and transfer ideas and innovations.

The shared sustainability ambition in various communities is another major enabler in the transfer of innovations. We observed a diverse palette of communities and ambitions. The fab lab community is a global community, with self-sufficiency and open source as its main ambitions. The low-tech community, on the other hand, is a global community but also has regional and local groups. These groups all have shared sustainability ambitions. The repair cafés are part of a local and regional community centred around sustainability and circularity. Some interviewees mentioned these communities and networks as enablers for transfer. The networks may operate on a regional scale (in the case of repair cafés) or on a global scale (in the case of fab labs). For the interviewees, communities and networks are probably overlapping concepts.

In Toulouse, the local and regional governments play a distinct role as enabling actors for the transfer of innovations. They have formulated an ambitious open innovation and open source strategy for the region (Van den Heiligenberg et al., 2018).

As most important project-internal conditions, the interviewees mentioned the documentation of fab lab prototypes, the skills of the people involved, the openness of the sender and the use of a signifier. As a non-localised context condition, they mentioned the media attention for the sender.

4.5. Comparison of the four city-regions: transfer pathways and harbours

We compare the cases on two main elements of our conceptual framework: the transfer pathways and the harbours. We observe a marked contrast in transfer pathways between the cases, mainly along the ‘knowledge’ dimension, i.e. the use of codified versus tacit knowledge in the experiments (see Fig. 3). We did not find large differences along the ‘governance’ dimension, i.e. between the guided and the grassroots experiments.

The transfer pathways are compared in Fig. 4. The technological parts (containing mainly codified knowledge) of the innovation are transferred relatively easily during various meetings; they are not strongly embedded in the regional context. This is most clearly visible in the case of the Valencia – science park. Here, innovations travel over larger distances to city-regions with similar economic characteristics. For the social innovations (in the cases of the Karlsruhe – future district and the Budapest – local urban food), the

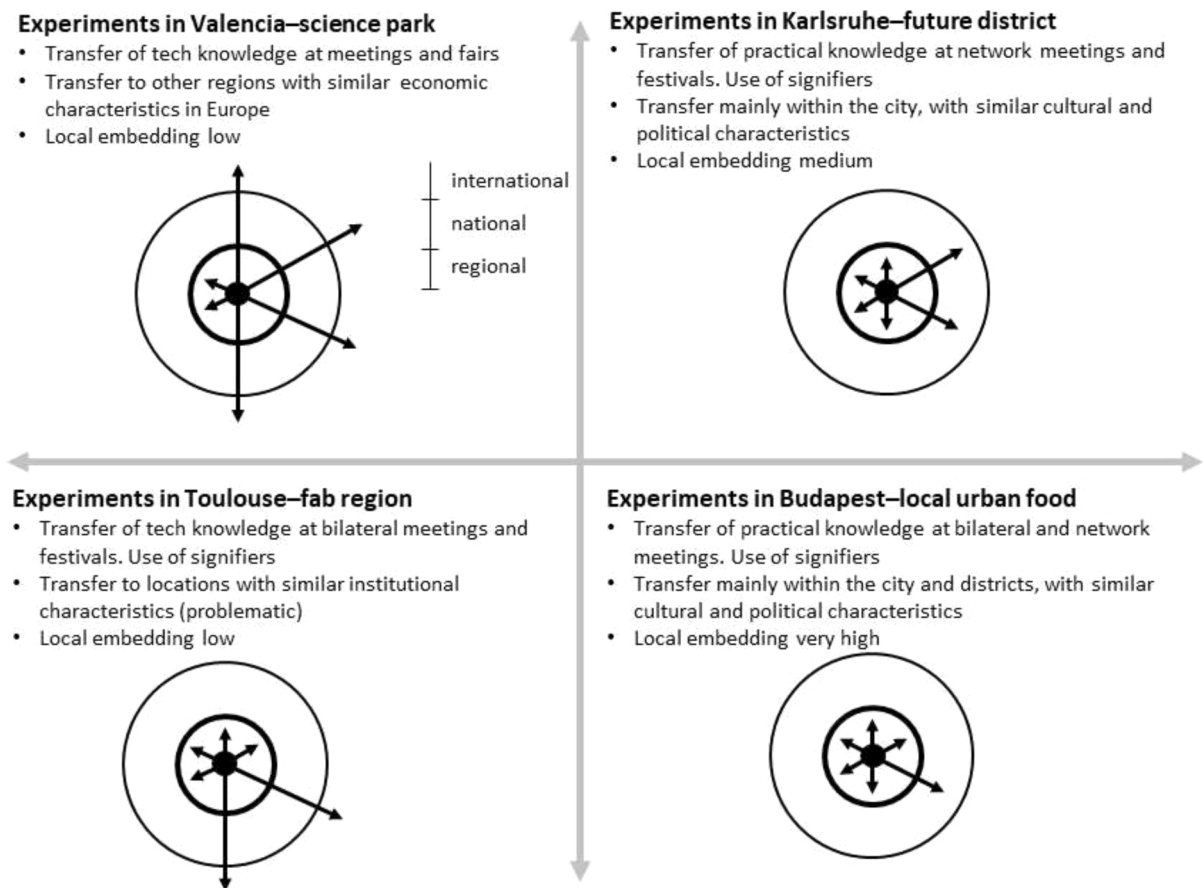


Fig. 4. The main contrast in the transfer pathways in the four cases. The schematic maps indicate the spatial transfer patterns of innovations to other locations in the region, in the country or outside the country. Each arrow represents the actual transfer of an individual project, as analysed in this paper.

transfer of innovations is more challenging. The experiments in these cases transfer practical knowledge during meetings and at festivals. The transferred knowledge has probably a more tacit character and the innovations are more embedded in the local cultural and institutional context. This may hamper translocal diffusion. On the other hand, the use of signifiers (i.e. distinct names concerning general concepts) may enable translocal diffusion (Silva et al., 2016). In our research, it was clear that some of the signifiers are known locally (such as the *Quartiersprojekt* in Karlsruhe), others are known regionally or nationally (such as *Szatyor Bolt* in Hungary, *Leihladen* in Germany and *Café Bricol* in the Toulouse region), and others are known globally (such as repair café). The spatial scales at which these recipes are known may influence their visibility and findability for potential successors who want to start a similar initiative, and thus they may influence translocal diffusion patterns.

Besides economic similarities, there are also other similarities between the sending and receiving regions that may facilitate the transfer. In the Toulouse – fab region and the Budapest – local urban food case, the innovations are transferred to other locations in the same district, city or region, which have similar cultural and political characteristics. The Karlsruhe – future district case shows that similarities can also be found in other cities in the same country. Finally, the fab labs in Toulouse show a high institutional similarity with other fab labs in the world. However, this did not result in frequent global transfer, since other factors hampered this transfer.

We also compare the cases on the local and regional context conditions (see Fig. 5), and on the importance of their combination (harbour). The contrast between the cases is visible in the transfer pathways but is less clearly present in the local and regional context conditions. We observe however some notable differences between the cases, especially in the type of enabling cultural conditions, the type of enabling networks and in the type of enabling government support. The social innovations are enabled by trust, this condition is not mentioned for the technological innovations. The technological innovations are enabled mostly by regional networks and by global networks (with a regional actor as a member of these networks), whereas the social innovations are enabled mostly by local and regional networks. In contrast to the technological innovations, social innovations are enabled by various forms of government support, such as financial support, organisation of network meetings, and publicity for the most innovative examples, for example by organising contests or by giving media attention to the innovations.

In all cases we found that the transfer of innovations is enabled by a combination of local and regional context conditions, i.e. by a harbour:

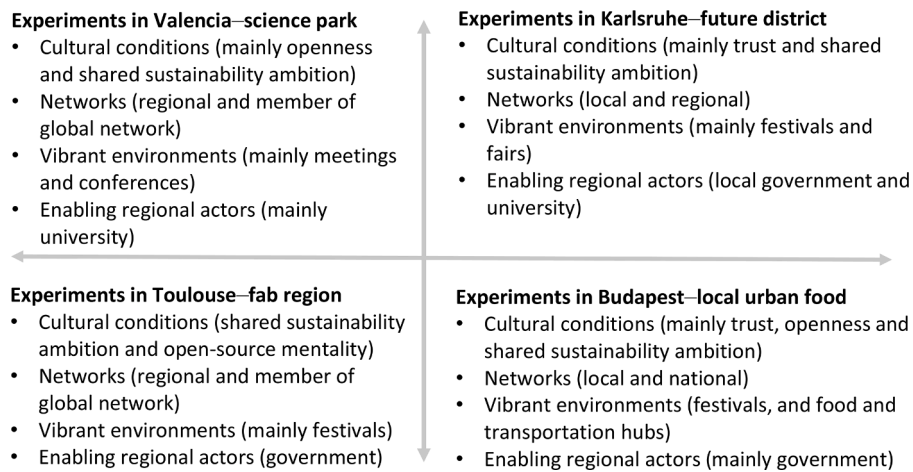


Fig. 5. Comparison of the localised context conditions in the four cases.

- In the Budapest case the transfer of knowledge takes place in vibrant environments (such as festivals), where the subculture meets. Local food networks support this transfer.
- In the Karlsruhe case the knowledge transfer is supported by local urban networks. These networks are organised by regional actors (the government and the university). In these networks the cultural conditions (e.g. trust) are essential.
- In the case of Valencia, regional and global networks exchange knowledge in a large variety of vibrant environments (e.g. meetings and conferences). Some of these conferences are organised by regional enabling actors (i.e. the university).
- In the case of Toulouse, the transfer of innovations is enabled by communities and regional and global networks, with shared cultural conditions (e.g. a shared sustainability ambition).

Regarding issues of scale, in this study we found that the various context conditions enabling transfer are mostly present on the spatial scale of a city (such as vibrant environments) or a region (such as some enabling regional actors). However, in the Budapest case some cultural conditions are located on the scale of a district, related to the localised density of countercultural groups on that scale. On the other hand, some enabling networks in the Valencia and Toulouse case had a global character.

Table 7 presents the main overall contrast between the four city-regions with respect to the type of experiments, the transfer pathways and the harbours. This contrast is mainly present between experiments for technological and social innovations. The Table also illustrates that there are various factors shaping the transfer pathways, including the travelling distances: the type of knowledge transferred, the degree of local embeddedness, similarities between sending and receiving region, the recognisability of recipes and various localised context conditions.

5. Discussion

The aim of this paper is to articulate the mechanisms involved in the transfer of innovations to other locations, including the local and regional context conditions enabling this transfer. Our main finding is that there is a sharp contrast in the pathways for experiments for technological innovation versus those for social innovation. With respect to the local and regional context conditions, we identified four context conditions enabling transfer. The contrast between the local and regional context conditions for the various types of experiments is low. In this section we discuss (i) the usefulness of the framework and (ii) the wider applicability of the results. We add a point of discussion regarding a remarkable finding compared to the current literature, namely (iii) the absence of replication.

The first point of discussion is how the novel conceptual framework proposed in this paper adds to our understanding of the transfer of sustainability innovations. Our conceptual framework brings together three building blocks from two different streams of literature. These building blocks were often used in the literature individually, but not in combination: experiments (Van den Heiligenberg et al., 2017), transfer pathways (Williams, 2017) and harbours (Torrens et al., 2019). We have shown that these building blocks are important in combination when analysing the translocal diffusion of sustainability innovations. We have shown that the various types of experiments travel through different transfer pathways, that this travelling requires several similar characteristics between the sending and receiving regions, and that the transfer is enabled by some different but mainly corresponding localised context conditions.

Regarding the differences in the localised context conditions, the contrast in general is low. We found however some notable differences between technological versus social innovations. This contrast is present for the following conditions: global networks, trust and government support. The importance of global networks for technological innovations can be explained by the found larger travelling distances of these innovations. Regarding trust, from the literature is known that compared to codified knowledge, the transfer of tacit knowledge requires more face-to-face interaction. For this, trust is of vital importance (Asheim & Gertler, 2006). With respect to government support, apparently the transfer of social innovations is enabled by various forms of support; in the Karlsruhe

Table 7

The main contrast in transfer pathways, harbours and project-internal conditions for experiments for technological and social innovations.

	Experiments for technological innovations transfer mainly codified knowledge...	Experiments for social innovations transfer mainly tacit knowledge...
Transfer pathways	...and for various sectors they are little embedded in local cultural and institutional contexts... ...and this may enable their travelling around the globe...	...and they are intermediately to highly embedded in local cultural and institutional contexts... ...and this may hamper their travelling, which is limited to locations with similar characteristics nearby... ...however, these spatial transfer patterns are influenced by the recognisability and the visibility of the recipes... ...this travelling may be enabled by (a combination of) local and regional networks,...
Harbours	...this travelling may be enabled by (a combination of) regional and global networks, some government support (visioning)and cultural conditions and generic vibrant environmentsvarious forms of government support (funding, organising network meetings, publicity)and cultural conditions (including trust) and generic vibrant environments
Project-internal conditions	...and their transfer is sometimes hampered by essential project-internal conditions	

case we observed a highly involved local government, giving support to the projects in various ways, by funding, organising network meetings and by giving publicity to the projects. We did not analyse whether social innovations need more forms of support for their transfer than technological innovations; it may be related to the absence of a market potential for some of these projects.

With respect to the local and regional context conditions, from the plethora in context conditions mentioned in the literature (see Table 1), we identified that there are four categories of conditions that are relevant to sustainability innovations: cultural conditions, networks, vibrant environments and a few enabling actors. Two of the context conditions belonging to these categories are understated or even absent in the current literature. The first is a shared sustainability ambition (which is a part of the category of cultural conditions). Although this factor is often mentioned in the literature as part of an articulated vision (Kemp et al., 1998), in this research we found an importance of a shared sustainability ambition in the community, and also between sending and receiving communities. The second is festivals (which are a part of the category of vibrant environments). Festivals play a remarkable role in fuelling the transfer of sustainability innovations. They can be conceptualised as temporary proximities where inventions are on display (Maskell et al., 2006). In economic geography literature, these proximities, such as fairs and conferences, are concentrated on the gatherings of people from firms. In our research, we observe that these gatherings are especially important for people with a shared sustainability ambition. Festivals are probably favourite meeting places for these people. This is also illustrated by our finding that face-to-face contact is used in about three quarters of the transfers. Festivals may be used by elites to establish a social distance between themselves and others (Waterman, 1998). This is reflected in our research, where countercultural groups gather to show and to discuss their sustainability innovations. In earlier research, it was observed that in Toulouse, ‘alternatives’ meet at a large festival, possibly rebelling against the mainstream (Van den Heiligenberg et al., 2018).

In all the four cases we found that the transfer of innovations is enabled by a combination of local and regional context conditions, as suggested in the literature concerning the harbour concept (see the Theory Section). To summarize the findings on this combination, we found that the transfer of innovations is enabled by *local and regional networks*, and that the members of these networks meet on *vibrant environments*, such as meetings, conferences and festivals. Some of these meetings are organised by *regional enabling actors*, such as the government and the university. In these networks, the *cultural conditions* (such as a shared sustainability ambition) are essential for transfer.

These findings demonstrate that the combination of localised context conditions may strengthen each other, e.g. the cultural conditions may strengthen the enabling role of networks.

The *second point of discussion* is the wider applicability of the results. Although there is a long history of studying the transfer and diffusion of innovations in general, the current paper is one of the first to systematically analyse the pathways and enabling conditions for the translocal diffusion of sustainability innovations. In order to cover the large variety of sustainability innovations, we selected contrasting cases that provided valuable insight into the various transfer mechanisms. Nevertheless, there are still important data limitations. The main limitation is that we analysed four distinct types of experiments in four city-regions only. Another type of experiments, for instance in another sector, in one of the four analysed city-regions may show different transfer pathways and different enabling localised context conditions. Furthermore, the four analysed cases will probably not cover the large variation in experiments and regional contexts in Europe. For example, city-regions may show great variation with respect to openness (such as city-regions in remote areas versus hubs with a high centrality), or with respect to distinct institutional, economic, political and cultural contexts. These variations may deeply influence the possibilities for transfer of innovations. We did not include experimentation in rural areas, nor did we execute a comprehensive analysis of receiving regions (we analysed the similarity with the sending region, but we did not analyse the localised context conditions enabling the transfer).

The *third point of discussion* is that replication is found to be almost entirely absent. This is in contrast to the recurring replication mechanism described in some transition literature. This literature may suggest that in the translocal diffusion, the innovation is adopted more or less unaltered by others (Turnheim et al., 2018). Some have a nuanced view on replication mechanisms. They state that although the technology can be replicated into a new context, this also requires an adaptation of the innovation to the local conditions in the new context (Ulsrud et al., 2018). In our research, we observed that 23 of a total of 24 experiments did not show

replication, i.e. an unaltered transfer. In almost every experiment, the innovation is ‘translated’; what travels is either only a part of the innovation, only the recipe (i.e. the generalised form of the innovation), or only an idea or an inspiration. Even when considering the technological innovations in our analyses, transfer appears not to be limited to a process of de-contextualisation and re-contextualisation; the technology itself is also translated, and this is often a translation towards a new prototype.

Related to this, we may conclude that for several analysed cases the transfer mechanism is not a linear process; here, various sources are used for developing a ‘receiving’ innovation.

6. Conclusions

In this study, we have addressed the following research question: What are typical pathways for the transfer of sustainability innovations to other locations, and how do local and regional conditions enable this transfer? Our main conclusion is that technological innovations and social innovations travel through different pathways. In general, technological innovations may travel easier around the globe compared to social innovations, they are not strongly embedded in the regional context. However, an important nuance is that various technological innovations in distinct sectors are characterized by a ‘customised valuation’ system, where products need to be tailored to specific user groups on a local or regional scale. These processes are dependant on the embedding in territorial contexts (Binz and Truffer, 2017). In this paper we show that almost all technological innovations were not replicated, but translated. This suggests that in (the early phase of) the innovation process, this customised valuation is the dominant valuation process.

The transfer of social innovations is more challenging. The transferred knowledge has probably a more tacit character and the innovations are more strongly embedded in the local cultural and institutional context. For these social innovations, signifiers are used, which may enable the translocal diffusion.

Our results suggest that the transfer of sustainability innovations to other locations is enabled by a combination of the following local and regional context conditions: cultural conditions (such as openness, trust and a shared sustainability ambition), local, regional and the membership of global networks, vibrant environments (festivals, conferences and fairs), and the presence of enabling regional actors (the government and the university). Finally, we also found some non-localised conditions, such as publicity (media coverage), and some project-internal conditions (documentation and skilled people) that enable transfer.

With these results we have addressed gaps in our understanding of the transfer mechanisms of sustainability innovations and of the conditions enabling this transfer. We have developed a new conceptual framework, in which the translocal diffusion is shaped by an interplay of types of experiments, transfer pathways and harbours.

The findings presented here allow us to derive practical policy recommendations. The intercity and interregional transfer of innovations are important topics for urban and regional policy makers. In the cases we analysed, much government effort has been put into the diffusion of good examples to other locations by providing financial support, by organising network meetings and by organising publicity. Our recommendation to policy makers on the local and regional scale is that they make a tailor-made analysis of the available and necessary pathways and localised context conditions enabling transfer. This may increase the effectiveness of the government efforts on diffusion. Many of these context conditions may be created or improved by local and regional policy makers and their partners. However, the analysis of the pathways highlights several obstacles for transfer, such as the challenging transfer of social innovations. These obstacles may be difficult to overcome.

We have two suggestions for further research. First, we recommend exploring in greater detail ‘what travels’, as a part of the transfer pathways. A great variety of things may travel, as was proposed in the article by Wiczorek et al. (2015). However, we observe that most of what travels consists of knowledge (and sometimes of technology). We discovered that this ‘knowledge’ is a broad collection of codified knowledge (such as software code, principles, prototypes and recipes) and tacit knowledge (such as inspiration, ideas, experiences and insights). Further research on what travels may help to gain a better understanding of transfer pathways for these various types of knowledge.

Second, we suggest establishing larger databases on sustainability innovations and conducting quantitative research on the transfer of sustainability innovations, thus capturing the large variation in the types of experiments, the local and regional contexts and their similarities in Europe. This variation may be large, but we are impressed by the shared sustainability ambition that we observed during this research in and across various communities and cities in Europe. This may be a sign that a common sustainability value pattern is emerging, which would be extremely relevant to the sustainability transition.

As an epilogue we would like to remark that the final phase of this research was conducted during the Covid-19 crisis. We assume that the crisis has had little or no impact on the results of this study because the transfers of innovations we analysed took place before the crisis. Nevertheless, this study shows that face-to-face contact was used in about three quarters of the transfers. In post-corona times, certain behavioural restrictions imposed during the crisis may lead to structural changes (such as fewer large-scale festivals or less global travelling). We are interested in and also concerned about the significance of these changes for the future diffusion of sustainability innovations as well as for the speed of change of the global sustainability transition.

Declaration of Competing Interest

None.

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Appendix A: Interview questions and list of interviews

Interview questions

In the interviews with the senders, we raised the following questions:

- 1a Description of sending experiment. Please describe your innovation (for firms: was it patented)?
- 1b Possibility for transfer. Was it possible to transfer the results of your experiment to a successive experiment in another location?
- 1c What was transferred and how? What was transferred to the new experiment (e.g. ideas, knowledge, insights, experienced people)? Was the solution completely copied or only partly?
- 1d Location of successive experiment. Where is the new experiment located (same region, similar region, same country, different country)? Do you have contact details of the receiver? Do I have your permission to interview the receiver?
- 1e Conditions enabling transfer. Which conditions were promoting this transfer?
- 1f Local/regional conditions for transfer. Which regional conditions were promoting this transfer? For example openness of the region, accessibility of the region, membership of networks, cultural characteristics (e.g. open-mindedness, trust), availability of skilled people?

In the interview with the receivers, we raised the following questions:

- 2a Description of receiving experiment. Please describe your innovation (for firms: was it patented)?
- 2b What was received? What was received (e.g. ideas, knowledge, insights, experienced people) from previous experiments, especially the experiment XXX (from the identified sender)? Was the solution completely copied or only partly? How was it transferred?
- 2c Conditions enabling transfer. Which general or regional conditions were promoting this transfer? For example, openness of the region, accessibility of the region, membership of networks, cultural characteristics (e.g. open-mindedness, trust), availability of skilled people?

List of interviews

Budapest – local urban food

Sending experiment (all located in Budapest)			Receiving experiment		
no.	Interviewee	Date of interview	no.	Interviewee	Date of interview
1.1	Owner of green walls company	27 February 2019	1.2	Owner of vertical gardens company (Budapest)	4 November 2019
1.3	Responsible gastronomy volunteer	5 March 2019	1.4	Restaurant manager (Budapest)*	N/A
1.5	Initiator of local food system	18 May 2018	1.6	Organiser of local food shop (Budapest)	23 October 2019
1.7	Foodbank project manager	28 February 2019	1.8	Foodbank director (Hajdú-Bihar, Hungary)	5 April 2019
1.9	Community gardens coordinator	4 March 2019	1.10	Community garden volunteer (Budapest)	19 March 2019
1.11	Collaborator in food packaging initiative	14 March 2019	1.12	Organiser of food packaging at event (Budapest)	1 April 2019

* Interview did not take place, unable to make contact.

Karlsruhe – future district

Sending experiment (all located in Karlsruhe)			Receiving experiment		
no.	Interviewee	Date of interview	no.	Interviewee	Date of interview
2.1	Team member of project on beekeeping	6 May 2019	2.2	Coordinator of urban gardening project (Karlsruhe)	1 October 2019
2.3	Initiator of project on creative workshops	7 May 2019	2.4	Team member of project on district activities (Karlsruhe)	7 October 2019
2.5	Team member of project on renting cargo bikes for free	7 May 2019	2.6	Policy advisor on cargo bikes (Karlsruhe)*	N/A
2.7	Owner of shop on sustainable clothing for children	26 September 2019	2.8	Employee of shop on renting clothing for children (Halle)	4 October 2019

(continued on next page)

(continued)

Sending experiment (all located in Karlsruhe)			Receiving experiment		
2.9	Coordinator of borrowing shop for free	23 September 2019	2.10	Coordinator of borrowing shop for free (Stuttgart)	2 October 2019
2.11	Coordinator of first shop on borrowing electronic devices for free	4 November 2019	2.12	Coordinator of second shop on borrowing electronic devices for free (Karlsruhe)	4 November 2019

* Interview did not take place, unable to make contact.

Valencia – science park

Sending experiment(all located in region Valencia)			Receiving experiment		
no.	Interviewee	Date of interview	no.	Interviewee	Date of interview
3.1	Researcher at firm on water-saving technology	29 October 2019	3.2	R&D firm (other country)*	N/A
3.3	Founder of start-up firm on solar energy for industrial processes	6 December 2019	3.4	Employee of firm on solar energy for industrial processes (Freiburg, Germany)	23 March 2020
3.5	Founder of start-up firm on car sharing for daily travel	2 December 2019	3.6	Competitor on car sharing (Paris, France)*	N/A
3.7	Researcher at firm on energy-efficient heating with microwave technology	29 November 2019	3.8	Firm on energy-efficient heating with microwave technology (university city, The Netherlands)*	N/A
3.9	Employee of start-up firm on preventing food waste with ICT	3 February 2020	3.10	Employee of start-up firm (social enterprise) on food donations & food waste (Castellon, Spain)	19 March 2019
3.11	Manager at start-up firm on CO2 reduction protocol	9 January 2020	3.12	Manager at association of firms in industrial area (Valencia, Spain)	10 March 2020

* Interview did not take place for confidentiality reasons.

Toulouse – fab region

Sending experiment(all located in region Toulouse)			Receiving experiment		
no.	Interviewee	Date of interview	no.	Interviewee	Date of interview
4.1	Developer of creative prototype at fab lab	1 October 2020	4.2	Innovation specialist at incubator (Mumbai, India)	9 October 2020
4.3	Developer of energy prototype at fab lab	8 October 2020	4.4	Developer of part of energy prototype (Toulouse)	30 October 2020
4.5	Developer of biotechnology prototype at fab lab	10 February 2020	4.6	Founder of start-up firm on biotechnology; same as sender (Toulouse, France)	10 February 2020
4.7	Fab lab innovations manager	2 March 2020	4.8	Fab lab innovations manager (Naples, Italy)*	N/A
4.9	Advisor of repair café for bikes	31 October 2017	4.10	Coordinator of repair café (Albi, France)*	N/A
4.11	Initiator of repair café	7 October 2020	4.12	Initiator of repair café (Toulouse region)	29 October 2020

* Interview did not take place, unable to make contact.

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