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Socio-Technical Transitions and Intermediaries: Lessons From the Gender Gap of Contraception for Future Inclusive Treatments

How can networks of intermediaries reinforce their potential in scaling up inclusive solutions and stimulating socio-technical transitions?

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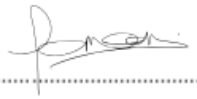

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Abstract

Why are cars fuelled and not electricized? Why did fuel cars win over electric cars? Why do we use plastic bottles for water rather than in cans that are 100% recyclable? Why are governments still dependent on nuclear energy and not wind power? Why do women bear the heavy burden of contraception when other ways exist? How can sustainable and/or inclusive solutions replace their unsustainable and/or unbalanced alternatives and replace the dominant system? Sometimes it can looks like this is a world of possibilities in the form of low-hanging fruits but that they often remain just that: possibilities.

Niche projects and innovations are sprouting all around Europe. Yet, these projects do not always get to a stage where they can be expanded to a greater scale. There is an identifiable systemic policy failure where inclusive and/or sustainable innovations already do exist all around Europe, and are supported in different localities but are not scaled up. The end result paints a discouraging picture where Europe is composed of a plethora of pilot projects but they never acquire enough strength and the overwhelming support they need to scale up and disrupt the socio-technical system in place, or in political terms the *status quo*. How does an isolated idea in an isolated niche become mainstream?

The objective is clear: transitioning from existing unsustainable and unequal socio-technical regimes implementing sub-optimal solutions to sustainable and inclusive ones. This research will focus on inclusive socio-technical transitions, where the literature is lacking, rather than sustainable socio-technical transitions, which already has a considerable amount of research behind it. It will not concentrate on the validity of the projects but rather on the innovative processes, the networks and actors involved in it, their challenges, their opportunities, as well as a solution to answer the following question: *How can networks of intermediaries optimise their role in scaling up inclusive solutions to implement socio-technical transitions?*

Keywords

Scaling-up, socio-technical transitions, inclusivity, multi-level perspective, networks, intermediary actors, inclusive contraceptive system

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I. Introduction

Contraceptive methods have drastically changed society. It both adopted society and was adopted by society. The user environment, the business environment, the cultural environment, the community of experts and the long history of the legal background all had a role to play in the diffusion of contraceptive methods (Kanger, et al., 2019). The specificity of contraception lays in the fact that, for the most part, only half of the population are, in the strictest sense, users. Women are the users of several hormonal methods of contraception and men have a restricted role in the majority of the process. Condoms and vasectomy, the two options at their disposal, are only used in specific circumstances and are not always regarded as viable methods. Other methods include hormonal male contraception (HMC) like injections or non-hormonal methods like thermal male contraception (TMC) (Soufir & Mieusset, 2012), but these methods have been side-lined by the expert community. Oudshoorn writes:

> *'Path dependence in the field of contraceptive technology and reproductive biology [in the 1970s] had created a situation in which the basic knowledge of male reproductive biology, the expertise and techniques needed to synthesise male contraceptive drugs, and the infrastructure for clinical testing of any new male contraceptive technologies had remained largely unexplored, underdeveloped, and marginal' (2003).*

Regardless of this lack of research, commercialisation and cultural acceptance of male contraception, a network of organisations and individuals in France, and spreading to Belgium, has flourished these last few years with the view of developing male contraception, with the ultimate goal of implementing inclusive contraceptive treatments, where men are included the contraceptive process and where the responsibility is shared (Andro-switch, 2019). However, their impact remains limited. The development of their project is at an interesting stage. The technology has existed for some time but is has only recently been gaining some traction and interest from different actors. How can this network of actors optimise their resources to stimulate a socio-technical transition?

This depicted story of a network working on male contraception in a niche with the objective of inclusion perfectly captured the interest of this research in the struggles of coordinating a multitude

of similar projects, which run the risk that none of them eventually scales up and grows out of the niche. Additionally, this network, although they work on developing technologies and devices, are first and foremost activists. Inclusion is thus at the forefront of their agenda, as is the case in this research.

The study of socio-technical transitions, intermediaries and the multi-level perspective, which studies the diffusion of innovations across three levels, i.e. niches, regimes and landscape, have however been predominantly focused on sustainability. This thesis can thus be considered as an example of an application of these frameworks and concepts to inclusive transitions.

The problem

The implementation of inclusive socio-technical transitions, and in the case study of inclusive contraceptive treatments, and the quality of coordination in the market of intermediaries.

Policy relevance

The study of intermediary actors and their role in socio-technical transitions has been gaining traction as they have been suggested as key actors, because of their characteristic 'in-betweenness' nature. Intermediaries are actors that connect actors, institutions and infrastructures on different levels of the technological diffusion process. As such, they are believed to hold a great potential for stimulating change and knowledge on ways to support and reinforce their potential can be particularly valuable in order to implement socio-technical transitions towards sustainable and inclusive environments.

Research question & Research sub-questions

Research question:

How can networks of intermediaries reinforce their potential in scaling up inclusive solutions and stimulating socio-technical transitions?

RSQ 1:

How are intermediaries internally organised in the implementation of socio-technical transitions?

RSQ 2:

What are the positive and negative forces experienced by intermediaries in scaling up inclusive solutions and stimulating socio-technical transitions?

RSQ 3:

How can intermediaries internally organise to overcome negative forces and ultimately stimulate a socio-technical transition?

Summary of research plan

II. Literature Review	In this section, the literature on multi-level perspective, transition studies and socio-technical transitions is reviewed, and the literature gap on inclusive transitions is discussed. The role in intermediaries and their role in socio-technical transitions is also examined.
III. Data and method	In this section, the data and methodology is presented, as well as limitations.
IV. Case study analysis and discussion	In this section, the case study is analysed in two parts. The first part analyses the network and their role, and the second part analyses the societal embedding of inclusive contraceptive methods in external environments. The case study is then discussed and solutions are explored.
V. Concluding remarks	In this section, the research question and sub-questions are re-examined and area of future research are suggested.

II. Literature review

To answer the research question, '*How can networks of intermediaries reinforce their potential in scaling up inclusive solutions and stimulating socio-technical transitions?'*, several theoretical aspects need to be explored, starting with a literature review of studies focused on sustainable transitions and intermediary organisations. This part of the research will answer questions such as 'What is an inclusive socio-technical transition?' and 'What is the role of intermediary actors?'.

The next part of the literature review will introduce question of inclusive contraception, how the subject has been addressed so far, and the existing evidence of the diffusion of male contraception in society. This will also provide a stage for the introduction of the next research questions, RSQ2 '*What are the positive and negative forces experienced by intermediaries in scaling up inclusive solutions and stimulating socio-technical transitions?*' through an analysis of the societal embedding of male contraception, and RSQ3 '*How can intermediaries internally organise to overcome negative forces and ultimately stimulate a socio-technical transition?*'.

Literature review: the MLP, transition studies and socio-technical transitions

Governments all around the world are facing sustainability and social challenges at the same time as facing financial and public budget challenges. This three-way relationship makes for a daunting future. These are symptoms of systemic failures. Historically, the way scholars have treated systemic failures they could observe in their time has been with economic growth, in particular capital accumulation or well-functioning markets (Fagerberg & Mowery, 2005). Since the 1960s, some academics have looked into another way of treating systemic failures through innovation studies and have since then opened the horizons of social sciences (Fagerberg & Mowery, 2005).

Innovation is now recognised for its effect on economic and social changes and the research has not stopped growing ever since. Innovation studies is not just about new technologies, but it is also about new ideas and ways of facing the challenges imposed by modern society from global warming to economic and social inequalities and many more undesirable outcomes that will require both societal change and the unstoppable technological change to progress for the better.

Innovation studies have evolved against this backdrop of environmental change pressure and the question of how to support innovative solutions towards a sustainable and inclusive transition has become essential. The question of inclusive transitions will be explored in the next section exploring the literature gap of socio-technical transitions and inclusivity.

The literature surrounding sustainable transitions has blossomed these last two decades (Markard et al., 2012). From recent work, it is clear that the academic interest in technological innovation has shifted. It is no longer its contribution to economic growth of countries but as a stimulus for deeper social, technical and sustainable transitions (Markard et al., 2012). It is also linked to the observation that technology is no longer seen as simply a tool to stimulate productivity but has become part of society and fulfils *societal functions* like transportation, communication and social interactions, education and research, and even contraception (Geels, 2004). The users have incorporated them in their lifestyle and behaviours, the private sector has developed their business models and value chains around them, the public sector has organised their political and institutional structures as well as regulations to accommodate and conform to them (Rip and Kemp, 1998). The phrase 'socio-technical' reiterates this very idea of society and technology considered together in a system, niche, regime, landscape or transition. The societal domain - with its culture, practices, user behaviour, policies, rules, and even markets – is contemplated as a working system together with new technologies (Geels, 2004).

Geels defines *socio-technical systems* as systems of innovation that link the elements necessary to fulfil societal functions like transport, energy, food, etc (2004). Those 'necessary elements' designate all resources that are needed for technologies to fulfil their role or function for humanity, such as artefacts, knowledge, capital, labour and culture (Geels, 2004). ST-systems, contrarily to sectoral systems of innovation (Malerba, 2002), technological systems (Carlsson & Stankiewicz, 1991) and large technical systems (Hughes, 1983) do not merely look at the supply-side of innovation but also at the demand-side, and as such, the function of technology is not limited to the production and distribution of technology but is also defined in its application by the use of the artefacts, i.e. their cultural meaning, the complementary artefacts developed alongside, etc (Geels, 2004). While the literature has paid more attention to the way innovations come about, or the supply-side of innovation, socio-technical (ST-)systems open the discussion on the effect they have on the user and their environment, thus including the demand side in the mix. This analysis acknowledges the co-existence of technology and society and the mutual influences they have on each other.

ST-systems, according to Geels, should be distinguished with 'actors' and 'rules (or institutions)' (Geels, 2004). This distinction allows a deeper analysis in opening the 'black box of institutions' as it discusses the dynamics between the three elements and integrates actors and social groups as well as institutions (rules or regimes) as an integral part of the analysis and explanation of the way technical change occurs. These three analytic dimensions are closely inter-related and interact with each other. As such, they shape one another. Actors do not act alone but they operate in a certain technological context and according to certain norms and rules specific to their field, just as much as rules pertain to certain agendas, firm identity and evolution of technology. These mutual interactions can result in reinforcement of the other dimensions or re-shape them.

Socio-technical regimes come from Nelson and Winter who refer to cognitive routines shared by networks of engineers involved in R&D as 'technological regimes' (1982). The *multi-level perspective,* however, a framework which was born out of evolutionary models of technology development, defines socio-technical regimes as taking into account not only the rules embedded in a community of engineers or firms but also those which influence and model the behaviour and activities of other actors such as scientists, users, policymakers and societal groups (Geels, 2004). This alignment of the cognitive, normative and regulative rules form a socio-technical regime around a certain societal function such as transport, energy, food, etc. These three types of rules are borrowed from Scott's three institutional pillars (1995). *Regulative rules* are the formal laws and regulations that a the actors of a certain regime adhere to. *Normative rules* are the more informal values, norms, standards and hierarchies existing in this regime. *Cognitive rules* are less visible types of rules but are nonetheless well-enshrined. They are belief systems or principles, which have an influence on the direction of research and science.

In the case of male contraception in France, the regulative rules would refer to laws like the one was interpreted as forbidding men from undergoing a vasectomy procedure (Art. 222-9, French Criminal Code) or the one which implemented a cooling-off period of 4 months for male users to reflect and retract before sterilisation (n°2001-588 of 1 July 2001). The normative rules would refer to the shared value that sterilisation in men is considered a mutilation or the standard that doctors have a 'conscience clause', which is a legal right but is exercised according to their own ethics, that they can exercise whenever they like without any condemnation from peers (Art. R. 4127-47, Public Health Code). A striking example of how cognitive rules can affect the direction of science is gender bias, for example. If it is culturally inscribed that women take care of contraception in a

couple, this gender bias can have an effect on the interest of scientific research for male contraception (Soufir & Mieusset, 2012).

Regulative rules	**Normative rules**	**Cognitive rules**
Laws, regulations	Values, norms	Belief systems, principles
Coercive and sanctioned	*Morally and socially implemented*	*Culturally inscribed and reproduced*

Table 1. Regulative, normative and cognitive rules (own illustration based on Scott, 1995 and adapted to Geels, 2004)

Another addition of socio-technical regimes, as mentioned above, is the inclusion of actors other than engineers and firms to emphasize the role of users and policymakers' way of interpreting and handling the artefacts and the problematic they leave behind.

For example, in developing technology like smartphones, firms like Apple view their technology in a certain way and wish to push its progress further according to their vantage point. Their perspective, expectations and practices are not independent from other actors'. Smartphone is now part of human life and also has a lot of incidence on policies. Individuals also 'own' part of what a smartphone is and what (cognitive and normative) rules govern it in the sense that they are the ones choosing how to use it and building expectations of problem-solving onto firms. Policymakers are also involved in this technology as they are the ones most involved with technical standards and (normative) rules potentially favouring one or the other technology. The same holds true for contraceptive technologies like the thermal contraceptive underwear for men. The users adopt a certain point of view and this will influence not only their behaviour and attitude towards the object but also the rules governing it. The inclusion of the users in socio-technical regimes changes the question from 'is there a demand from users?' to 'what is the user's attitude and how does it affect the production-side?'.

In the *multi-level perspective* on socio-technical transitions, or MLP, Geels goes further in defining the role of regimes, the locus of shared practices and rules, as a stabiliser of existing systems (2002). It conveys this idea that technological change – especially one towards sustainability, which implicates durability – is embedded with all the societal dimensions that come with it, such as the users' expectations (Kemp et al., 1998). This explains why the socio-technical regime is a key concept in transitions research. The MLP is visually recognisable because of the three 'levels': the

niches, the regimes and the socio-technical landscape. The MLP is a dynamic framework and offers an explanation of how and from where socio-technical change occurs.

The *niches* are where radical innovations have the room to develop, they are the protective nurturing environments where an innovation can grow without the pressures of a real-life market (Geels, 2004). Niches are however unstable, in contrast with the regimes and the landscape. They can be organised or disorganised.

Socio-technical regime, as defined above, are the sets of rules shared by the actors within the dominant regime. They are, in the MLP picture, 'path-dependent' and provide stability, but they can be disrupted by an emergent innovation and rattle the 'lock-in'.

The *socio-technical landscape* encompasses the material infrastructure and the immaterial infrastructure, i.e. the political and social infrastructure (Geels, 2007). The immaterial infrastructures are phenomena and disruptions occurring at this level are seen as 'exogenous' forces (Geels, 2004, p.913; Jørgensen, 2012, p.998) which are outside of the playing field of actors, like 'globalization, environmental problems, cultural change' (Geels, 2007, p.129-130). The material structures are the physical structures and technologies widespread around the world, which appear as barriers to change and reinforce path-dependency of some technologies. For example, transitioning away from transport systems like highways or services like electricity would be incredibly difficult, partly due to physical infrastructures that have invested and spread in civilization.

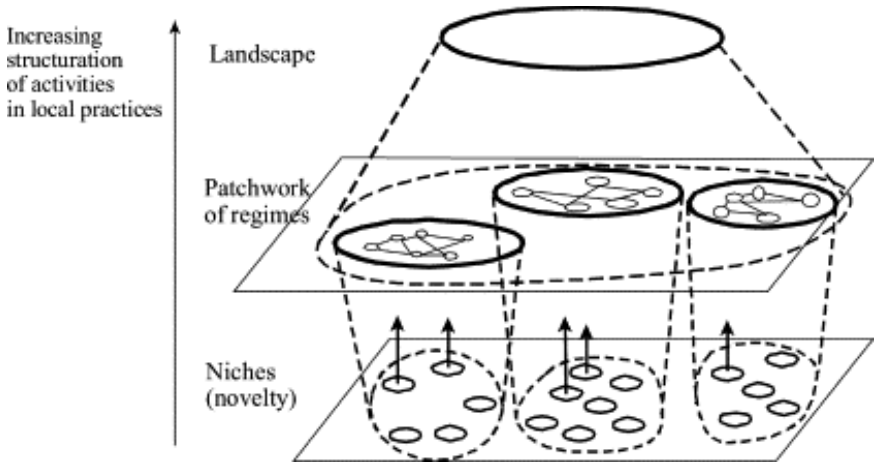

Fig x. Regimes from the multiple-level perspective (Geels, 2002).

The multi-level perspective is a dynamic framework and envisions change in the form of *socio-technical transitions,* which mark the transition from a socio-technical regime to another (Geels & Schot, 2007). Such transition goes hand-in-hand with a change in socio-technical systems because the regime plays a big part in the stability of the system and the dynamics with the actors and regime-rules (Geels, 2002). Literary reviews of the research done in innovation policy and transitions put in evidence four frameworks: transition management, strategic niche management, technological innovation systems and the multi-level perspective on socio-technical transitions (Markard et al., 2012; Sengers et al., 2016; Safarzyńska et al., 2012).

Of the many theories and frameworks that pay attention to transitions, the multi-level perspective offers a vision on transitions that is intuitive, both visually – as seen in Figure 1 – and analytically (Geels, 2002).

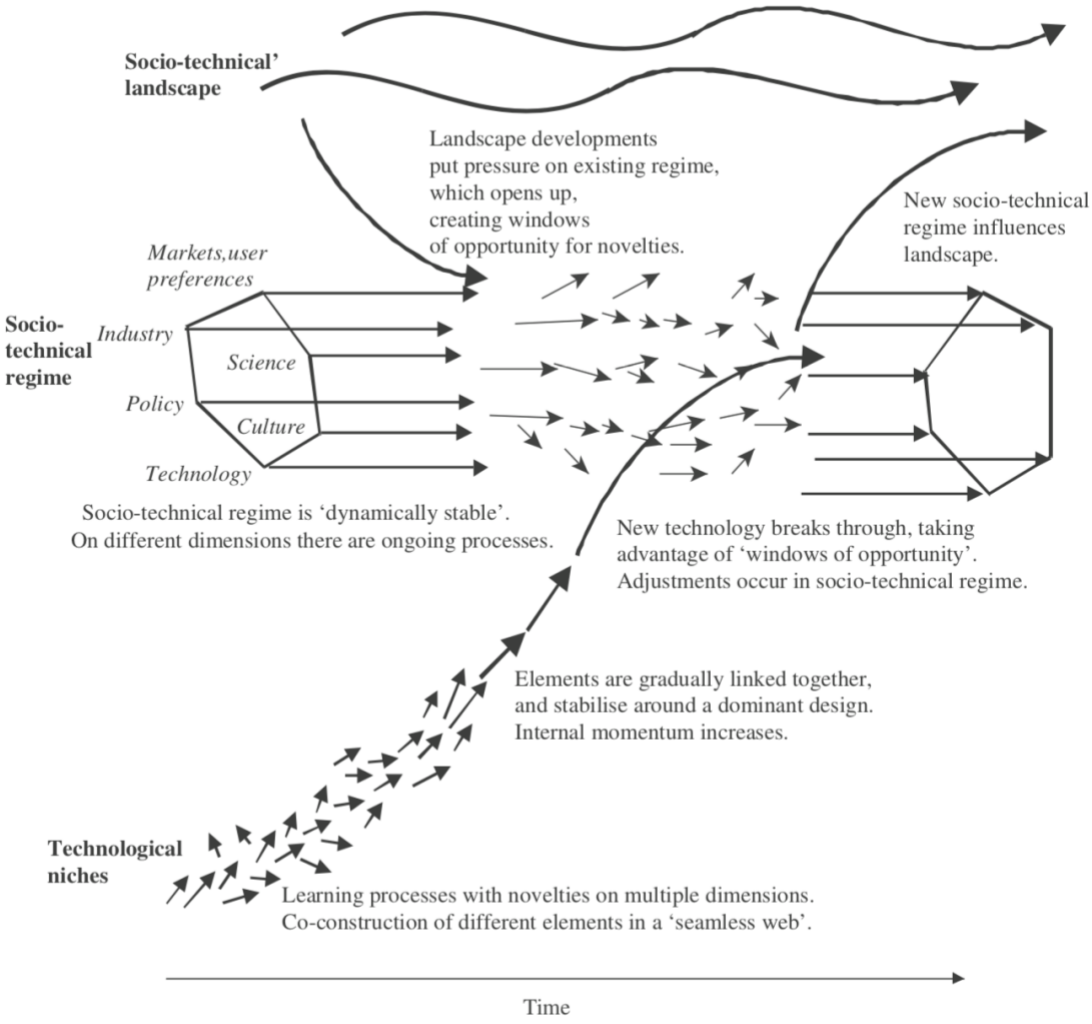

Figure 1. A dynamic multi-level perspective on socio-technical transitions (Geels, 2002, p.1263)

Socio-technical transitions and societal embedding: positive and negative forces

As seen in Figure 1, the theory goes that socio-technical transition occurs when 'elements are gradually linked together and stabilise around a dominant design' and there is 'pressure on existing regimes' from the landscape (Geels, 2002). This diffusion and these dynamics have been explained as 'co-evolutions' of society and technology, and co-evolution between different domains and systems (Geels, 2005). For example, hormonal contraception methods for women have been offered on the market because of technology development in niches, but also because some women actively sought to have it and the culture changed to allow their access (Watkins, 2001). This introduction in the market required several other 'systems' have to adapt and develop alongside, such as the medical field, policies, etc.

In order to complement the MLP and these dynamics between technology, society and different domains, the notion of *societal embedding* is suggested.

Kanger and colleagues, in their research focused on understanding technological diffusion as a process of societal embedding, have suggested a framework of five dimensions: embedding in user environments, embedding in the business environment, cultural embedding, regulatory embedding, and embedding in the transnational community, i.e. experts (Kanger et al., 2019). This concept embodies the fact that the diffusion of a technology affects different societal domains, and thus involves more than the actors on the demand-side or production-side. It also proposes that there are not simply 'barriers' or 'opportunities' arising from one domain but the adoption of technology is a process in a certain environment that exerts a certain force, positive or negative.

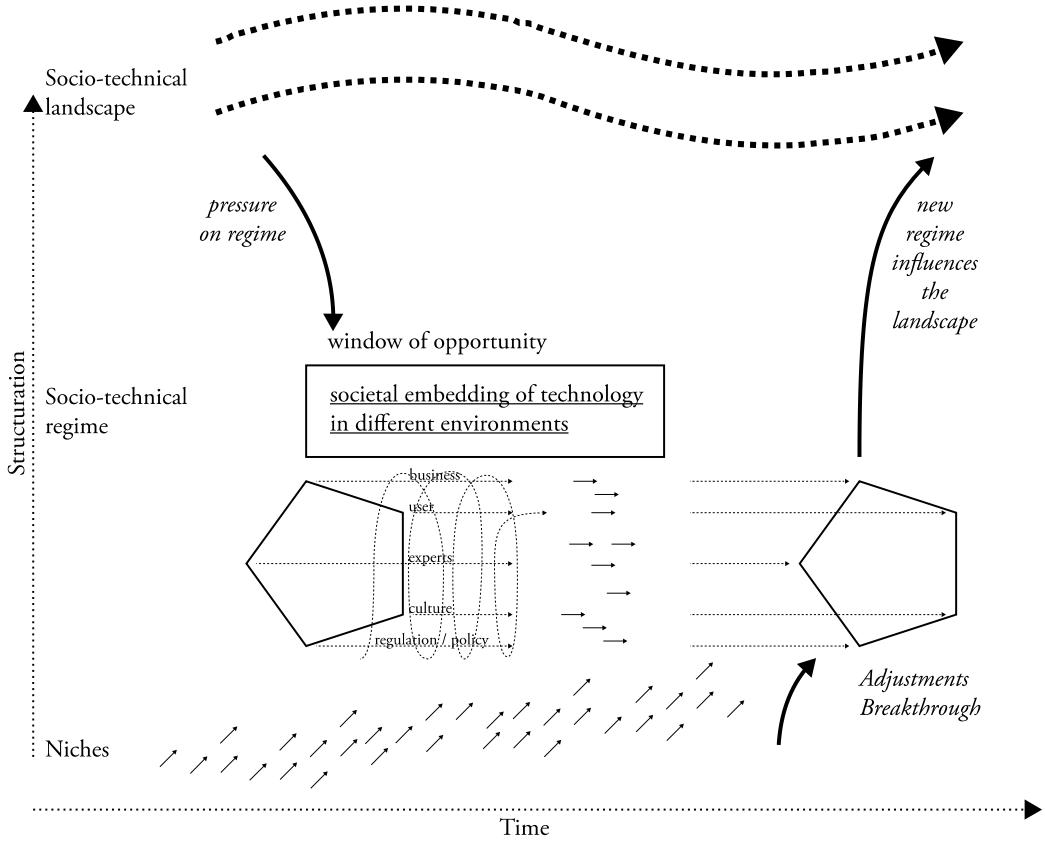

Figure 2 Socio-technical transitions as societal embedding (own representation, adapted from Geels, 2002, p.126; and Kanger et al., 2019).

These five domains or environments can complement the MLP, as seen in Figure 2, as a socio-technical transition posits a co-evolutionary change from several systems, or domains, as well as a co-evolutionary change in technology and society. Societal embedding explains these phenomena by considering that a certain technology is 'diffused' or 'instilled' into these five societal domains. This can also be a way of responding to the criticism of Safarzyńska et al. (2012, p.1018), supporting Winder et al. (2005), that the term 'co-evolution' is misused in the MLP.

Inclusive socio-technical transitions: a gap in the literature

The literature on socio-technical transitions has developed from a desire to study and offer insights into sustainable development and model the role of technology development in that process, and as such it has been focused on sustainable transitions (Kemp et al., 1998; Smith et al., 2005; Berkhout et al., 2004; Jørgensen, 2012; Markard et al., 2012; Safarzyńska et al., 2012; Sengers et al.,

2016;). The MLP has been applied for all sorts of dimensions of sustainable socio-technical transitions, such as low-carbon energy (Geels, 2012; Geels, 2014; Geels, 2018), electric cars (Garud & Ghehman, 2012; Mazur et al., 2015; Nykvist & Nilsson, 2015; Nilsson & Nykvist, 2016), or sustainable food systems (Hinrichs, 2014).

However, the reasons behind the exclusivity of the affiliation of the framework to the topic of sustainability are unclear. The multi-level perspective as built on the work of by the work of Rip and Kemp (1998) and developed by Geels (2002) explained innovation diffusion by the interaction of three micro-, meso- and macro-levels: the niches at the bottom, the regimes at the meso-level, and the overshadowing landscape. While the issue of sustainability was associated early on in the literature with the MLP and socio-technical transitions, the issue of inclusivity has not been clearly incorporated into the framework. With the exception of a few studies like Onsongo & Schot (2017), opening the door for inclusivity to be studied with MLP, the cross-over between socio-technical transitions and inclusive transitions has never hardly been explored, forming a gap in the literature.

This framework is difficult to set aside when analysing a transition from a system that uses one technology to another system that uses a new technology, as well as the co-evolutive relation of societal dimensions and the new technology. For this reason, inclusive innovations and their diffusion from niches to regimes should be explored with the help of the MLP. As much as the framework has developed against the backdrop of environmental change, an interesting turn could be taken in favour of inclusive socio-technical transitions.

First, the notion of 'inclusive innovation' has to be tackled in order to move forward: *what is 'inclusion' and what does an 'inclusive socio-technical transition' look like?*

Inclusion

There are several dimensions and definition of inclusion, which in turn impacts what is perceived as an inclusive innovation (Schillo & Robinson, 2017). Narrower definitions of inclusion designate economic or income poverty, but attention to other dimensions of the notion have now broadened the discussion (Hicks, 2013). Sen offers a broader concept of 'social exclusion' (2000), as designating excluded groups, which brings to light other dimensions – economic, social, political – playing a part in building inclusive societies. Some even explore a temporal element in pointing to groups who have experienced social exclusion and those who will experience exclusion in the

future, for example because of job replacement by Artificial Intelligence or migration policies (Schillo & Robinson, 2017). Many groups can be socially excluded in a certain societal dimensions because of different reasons, including religion, age, ethnicity, poverty and gender.

Inclusive socio-technical transition

The link between innovation and inclusion has been explored by Onsongo & Schot (2017), opening the door for inclusivity to be studied with MLP, and with the help the ladder of inclusive innovation, introduced by Heeks, Amalia, Kintu and Shah (2013). They offer a 6-level framework: intention, consumption, impact, process, structure (institutional), post-structure (2013).

This ladder is useful for measuring which 'level' of inclusion some policies integrate. The OECD, for example, adopts in their Framework for Policy Action on Inclusive Growth the view that innovation can have a part in 'inclusive growth' and 'create opportunity for all segments of the population and distributes the dividends of increased prosperity, both in monetary and non-monetary terms, fairly across society' (2018a). Their objective is to support inclusive innovation policies which will remove barriers and offer all individuals equal opportunities to successfully participate in and benefit from innovation (OECD, 2018a). They mark the distinction between three types of inclusiveness in inclusive growth: social inclusiveness, industrial inclusiveness, and territorial inclusiveness (OECD, 2018b, p109). These promote the inclusion of disadvantaged groups, industries or regions and areas into the process of innovation. The OECD's Framework can be considered a level-four or level-five policy, as it indicates their dedication for inclusion in 'participation', within the process of innovation.

However, at the sixth level, the ladder suggest a post-structural inclusion, which targets the cognitive routines (Heeks et al., 2013). This hints at a higher level of inclusion focusing on discourse, language, knowledge framing or in a sense a more immaterial and generalized way of showing societal acceptance.
Going back to the definition of a regime as an ensemble of regulative, normative and cognitive rules and as applied to the ladder of inclusive innovation (Geels, 2004), this means that post-structural inclusion occurs at the regime-level. Therefore, in order to *really* change a regime and operate an inclusive socio-technical transition, the level of inclusion has to be at the sixth level.

This research will thus apply the following working definition: *an inclusive socio-technical transition refers to a transition from a dominant regime to a regime where inclusivity in a particular societal function is inscribed within the shared regulative, normative and cognitive rules.*

The level of inclusion which is targeted in this research is the *level six*, a post-structural inclusion which targets the cognitive routines as the foundation of any innovation policy (Heeks et al., 2013). This means that the discourse, language used, integrated knowledge, and direction of innovation development are addressed (Heeks et al., 2013). In other words, it has to be 'societally embedded'.

Literature review: intermediaries and their role in (inclusive) socio-technical transitions

Introducing intermediaries

Building an inclusive and sustainable society will require change and as such, changes in regime rules and changes in the socio-technical systems, which perform societal functions like energy, food, health, mobility, and sub-functions like the production, distribution and use (Geels & Kemp, 2007). In the multi-level perspective, the transition from a socio-technical regime to another happens because a 'window of opportunity' is opened, caused by a technology developed in niches and a mismatch in a changing landscape with the regime (Geels & Kemp, 2007). These elements allow a transition in the regime, such as the transition from cesspools to integrated sewer systems, from landlines to mobile phones or from barrier-based contraception to hormonal-based contraception. This process of technology development in niches has been studied mainly in a market-based context of 'readiness' and competitiveness of the technology (Smith et al., 2010). However, a transition of socio-technical system not only equates to a change in the technology and the infrastructures, but also implies a shift in the relations between technology and the actors, the actors and the rules governing the system as well as the rules and the technology.
Considering a transition is connected to the entire context surrounding it, the putting in motion a process of replacement of an existing socio-technical system thus calls for intermediary intervention. Flowing from this reasoning, a few early studies on intermediary organisations started to appear (Van Lente et al,. 2003; Geels and Deuten, 2006). Other studies have followed, but they have remained mainly focused on sustainability transitions without paying much attention to inclusiveness (Moss, 2009; Guy et al., 2011; Mignon & Kanda, 2018; Kivimaa et al., 2019).

Intermediaries as intermediary locus?

The literature has presented intermediary actors in various ways and has granted them various roles and activities, but notwithstanding these differences, what defines intermediary organisations is their 'in-betweenness' or 'relational work' between different actors (Moss, 2009).

These intermediaries are thus characterised as actors using their relational quality in the context of scaling up projects located in niches. They are the connection between the knowledge and practice of, the new niche on the one side, and the regime in place on the other. Geels and Raven dissect this relational work intermediary organisations do and divide this main role into three roles: aggregate knowledge, foster networking and coordinate local projects (2006). Heagraves et al., in research the community energy sector in the UK suggest that a third role is underway: brokering partnerships with actors outside the community and engage in lobbying activities. They warn however that this new role somewhat goes against the diversity in of the niche, which is filled with diversity and vibrant projects going against mainstream routes. Lobbying to policymakers and managing partnerships with firms and companies comes with the cost of having to coordinate objectives and activities. All projects and the community nurturing them are not destined nor willing to conform.

This limitation to those three roles described in Geels and Raven's framework can probably be explained to the fact that they see these organisations as coordinators *within* the niche (2006). In their view, intermediaries are exclusively located in the niche, to aggregate multiple niche projects and coordinate them to build and manage a 'global niche'. A global niche is the combination of these multitude of local project forming a community sharing rules and practices (Geels and Raven, 2006). However, other authors have not stopped to the locus of the intermediary to define it.

Intermediaries as a connector

The literature on intermediaries has been recognised as 'inconsistent' due to the lack of clear foundations, and as such, the different pieces do not quite fit together (Kivimaa et al., 2019). Just like Geels and Raven have limited their work on intermediaries to a role of managing global niches (2006), some have explored the existence of 'systemic' intermediaries beyond 'hard' or 'soft' intermediaries (Van Lente et al., 2003), some have gone further and differentiated them by source of funding, scope of action and target audience (Mignon & Kanda, 2018), and others built on

Geels an Raven to explore on specific topics like community energy niches (Hargreaves et al., 2013; Seyfang et al., 2013; Ruggiero, 2018). In any case, it is clear that the literature dedicated to the genre is building up and there is no dominant definition or framework so far.
To remedy this situation, Kivimaa and colleagues have recently retraced the steps taken by different approaches and built a typology of five (non-exclusive) types of intermediaries, according to two criteria: the level at which they operate and their motivations or 'degree of neutrality and agency' (2019).

1. The *systemic intermediary* focuses on managing outside relationships with the overarching goal of gathering public acceptance of a certain technology. They are established networks or organisations with the purpose of being intermediaries. This type of intermediary could explain the unexpected findings made by Hargreaves et al. (2013) on intermediaries which engage in lobbying activities and managing relationships outside of the community with private or public partners. They build relationships outside of the community, make alliances, aiming at social and cultural acceptance. In this particular context, roles may differ: they could be 'negotiators' between the niche- and the regime- level and their different interests, knowledge, visions, or they could be 'translators' attempting to implement certain practices or make new regulations more understandable.

2. The *regime-based transition intermediary* acts between different fields, different networks, across regions and countries among the same regime. They are more likely here to be a platform of exchange and co-creation.

3. The *niche intermediary* is the intermediary acting at the niche-level and it takes part in different activities, from building global niches (Geels and Deuten, 2006), grassroot movements or individual (or excluded) movements. It has three roles: aggregation of knowledge, coordination – creation of an institutional structure, framing and coordinating –, and relational work (Geels and Deuten, 2006, see p.274).

4. The *process intermediary* develops connections and develops projects without participating much in shaping the perspectives and objectives of the transition. In the 'Brussels bubble', these organisations are very present, they are professionalised intermediaries

5. The *user intermediary* articulates adoption or (future) demands (Kivimaa, et al., 2019). They can have an activist strand, and can be users themselves. The actor can be organised as a an advocacy or discussion group around the specific technology (Kanger & Schot, 2016).

	Locus and interactions	**Motivations and interests**
Systemic intermediary	Regime-level, with niche-level and regime-level actors	Neutral position, dedicated and established as an intermediary, with an interest in supporting the transition
Regime-based transition intermediary	Regime-level, with regime-level actors	Involved in the regime's activities but dedicated to change, from within and with the dominant regime actors
Niche (or grassroot) intermediary	Niche-level, with niche-level and regime-level actors	Aggregation of niche actors, development of a particular niche
Process intermediary	'In-between', with niche-level and regime-level actors	Neutral position, established or employed as an intermediary
User intermediary	'In-between', with niche-level and regime-level actors	Involved/activists in the users' interests, brokers of information

Table 2. Transition intermediaries (own table, based on Kivimaa et al., 2019)

A socio-technical transition, as theorized in the MLP, occurs when a technological solution, developed by a network of actors, is '*selected out'* by the regime, which was stabilized by a network of actors. In this scenario, Garud and Gehman point out that actors can be considered differently than 'selection environments', as is dictated by the ontological assumption made by evolutionary perspectives (2012). In other words, the market of intermediaries does not work like a market. Adopting this view means perceiving the systems of innovation and the transitions as fluid

mechanisms. It is not path-dependent but is formed through 'fluid mechanisms' like alignments tough negotiations, conflicts, etc which are themselves formed by the actors meshed with the technology and form the interpretation of that technology.

According to this view, a 'trial of strengths' (Latour, 1987) is happening and the success of a technology is not due to its competitive strength but is also attributable to the people behind it. As such, a strong network is able to shape perspectives and attract attention can make it a success. This can explain why the attention to intermediaries is increasing as they are key actors in building these networks and constitute an important resource, not only to draw interest into the research, but also to shape favourable perspectives and thus shape the new regime. Intermediary organisations have become a new actor in governance and in socio-technical systems.

III. Data and Method

Data collection

The unit of analysis being intermediaries, the sample selected for this study consists of 12 organisations or individuals. To collect the data, 12 separate interviews of 30 to 90 minutes were conducted from 1 July 2019 to 26 August 2019. The collection of data was either conducted via telephone or via face-to-face interviews, the difference being mostly owed to geographic constraints as the respondents were located in various part of France and Belgium. Telephone interviews do have the advantage of avoiding some interviewer bias and to some extent provide a certain additional level of anonymity (Hagan, 2006), although they do bar any visual cues to be observed, while the opposite is true for face-to-face interviews (Lune & Berg, 2016).
The interviews were semi-structured or 'semi-standardized' as they were guided by a questionnaire but they were not strictly lead by it (Ross & Matthews, 2010; Lune & Berg, 2016), designed to allow more in-depth insights into their activities and perspectives. The wording of the questions and the sequence of the interviews could also depend on the participant and the direction of the conversation. In a way, the semi-structed nature of the interviews allows for the participant to have a certain command over the conversation and for the researcher to be less active, whilst remaining present. Since participants could have different backgrounds and not all questions would make sense, and in order to ensure that the interview would tackle every themes of interest, the questions were divided into five separate sections.

1. The questions started with 'warm-up questions' centred around their own activities and objectives. This part is important for different reasons. They are familiar territory for the participant, and they allow them to get invested into the questions (Grinnell & Unrau, 2005). It is also helpful in setting the stage and fully discern the role they play in the transition towards inclusive contraception (Lune & Berg, 2016). Some attention is also paid to funding and the evolution of their role since they started their activities.

2. The second section goes on to establish their network, their relations with other intermediaries as well as the actors they consider important or influential in their field. This second round of questions will later help to draw out how the network is structured as well as the quality of the relations they maintain amongst each other.

3. The third section focuses on the impact the participants consider to have delivered, with a particular look at their target audience and the change they could have encountered in their attitudes. This notion of impact introduces a notion of temporal element and is useful to determine whether, from their point of view, there has been some change and/or evolution and whether signs of a transition are cropping up.

4. The fourth section adds on the former and introduces to notion of 'societal embedding'. This section explores the instilment and diffusion of innovations, technologies and artefacts – such as male contraception – into societal dimensions – such as user environment, business environment, culture, regulations and expert communities (Kanger et al., 2019). The participants can then share their own views on the inclusive contraception and barriers and/or challenges they encounter or observe in their own actions to support the socio-technical transition. When focusing on societal embedding in different dimensions of society, they can delve into external elements and external barriers they might have encountered. This also gives the opportunity to see what internal actions are already taking place to counter these external factors.

5. The fifth and last section was designed to as open-ended as possible and let the participant think about solutions to the barriers they have encountered.

Data selection

The first round of participants were first selected on first impressions of their roles as intermediaries, based on online research. Then, after a careful analysis, those participants which did not fit the profile based on their type of intermediary and geographical location, were rejected. 13 interviews were conducted, and from those 13 interviews, one was rejected because the participant or their organisation fit none of the working definitions of 'intermediary' from Kivimaa et al.'s typology (2019) and was geographically and socially too remote to the existing network in France and Belgium. Of those 13 interviews, 2 were from the same organisation, leaving the count to 11 actors or 'intermediaries'.

Of the 11 intermediaries selected, six were established in Belgium while the rest were established in France.

	Belgium	**France**	**Total**
Country of establishment	5	6	11

What seemed essential beforehand was to identify their field of activity and their angle of approach to inclusive contraception. It is rather clear that at first glance, they appear to belong to very different fields of activity.

	Field of activity
Family planning centre or Federation	3
Associative sector	7
Animation, education & training	1
Total	11

Four actors were identified as carrying out work in the sphere of family planning, four in the associative sector and one in animation, education and training. Although they could seem as belonging to different professional fields, they are closely related. Family planning centres and Federations, for example, are in fact associations and often conduct in animations and education and training sessions (Décret, 18 July 2001). Also, it cannot be excluded that actors in the associative sector are involved in educational purposes and vice versa.

	Thematic focus (objectives and activities) (Gr=30)
Abortion/Abortion rights	6
Anatomical/Sexual/Emotional life education	9
Contraception	11
Education & training	3
Gender issues/biases	9
Health & (de)medicalisation	5
Medicalization	5
Environmental dimension	4

Not only are their respective fields different but their thematic focuses also differ. In their objective and activities, it also clear that contraception is not the only subject of interest to these intermediaries. The intermediaries were not selected because their primary focus was the diffusion of male contraception technologies or methods, but because they at some point were confronted with the issue, in the form of project or side activity. This explains why not all participants have cited 'contraception' as their thematic focus.

Qualitative methodology and data analysis

Intermediary organisations or actors have been presented as potential key players in sustainable socio-technical transitions by the literature. This results are limited to sustainable transitions, but it is postulated that they could be extended to inclusive transitions. The hypotheses are that inclusive socio-technical transitions being considered as a process of societal embedding, intermediary actors are also central to the diffusion of inclusive innovations. This infers that the MLP is transferrable to inclusive socio-technical transitions and is not limited to sustainable transition studies.

To research the role of intermediaries on societal embedding within socio-technical transitions, a qualitative methodology, as opposed to quantitative methodology, was deemed to the most appropriate to analyse the role of an actor in a complex process. To understand why, going back to the nature of intermediaries as a unit of analysis. They organise the different actors in transition processes, they coordinate and they inform, with the object of capitalizing the momentum in windows of opportunities and implement the change of socio-technical systems (Gliedt, et al., 2018). If these windows are not exogenous processes but are the result of numerous activities that they do, quantitative analysis cannot fully explain how and why these windows allow for a certain innovation to come through. The objective is to approach the unit of analysis, i.e. intermediaries, and inquire into their role, activities and objectives and thus include their own perspective. This intention of studying 'within' a phenomenon, or a 'class of events' (George & Bennett, 2004, p.17) calls for a naturalistic approach and in turn assumes a qualitative study (Denzin & Lincoln, 2011, p.3).

The nature of the research is inductive, in the sense that apart from the frameworks and theory surrounding the formulation of the research, the findings are constructed from the 'ground up' (Cresswell, 2013). The importance to minimalize the assumptions made on the subject of intermediaries and male contraception to better highlight the actors in their own discourse and context interacting with them was primordial.

Case studies: trade-offs

In order to effectively research this question in the context of male contraception, the case study was invaluable. The literature has often approached socio-technical transitions with case studies, as they attempt to paint a holistic picture of a series of intervening variables (Geels & Kemp, 2007; Lopolito et al., 2011; Raven et al., 2012). Complex processes such as those of socio-technical transitions, which implicate large numbers of actors, policies, scientific and historical development are difficult, if not impossible, to measure. However, case studies, historically called 'small-n studies', have often been considered invalid in the history of social sciences (King et al., 1994). This 'flaw' is even more present in single-case studies. King et al. however argue that case studies take away in replicability, they arguably make up for in conceptual validity, identification of new hypotheses, exploration of complex causal mechanisms and modelling and assessing these relations (1994, p.19-22). This is because case studies allow for deeper analyses of variables. This

prevents not only risks of conceptual stretching from diverging cases, but also risks of the inability of the model to explain deviant cases and causality while real-life event do allow such possibilities.

These referred qualities inescapably incur trade-offs, such as case selection bias, lack of representativeness, and omitted variables.

As mentioned above, the case selection bias is a considerable limitation, even more so in a single-case study. It can cause a myopic view and compromise the results in over-stating and/or over-generalizing them. It is thus very important to re-frame the results of this research within its own context. The case study at hand is situated in a particular geographic and socio-economic background, which should not and could not be applied to another. For the same reasons, the 'lack of representativeness' stemming from the case research is to be expected. The research and the case is centred around a network of intermediaries operating in a contemporary Belgo-French context and any conclusions beyond these conditions should be rejected. It should also be clear that these intermediaries address a specific type of public: heterosexual and cisgender males and/or couples. Also, the data presented here may not represent the entirety of Belgian and French intermediaries acting for an inclusive contraceptive system.

It is important to note that the way a case study is helpful in explaining *how* and *whether* a certain process is occurring, such as societal embedding in socio-technical transitions or the role of intermediaries in such transition, it also means it is less helpful in quantifying or measuring *how much* they have an effect.

Single-case study analysis

Yin offers a classification of different case studies according to their relation to the research question (2003). It can be a critical case, a unique case, a representative case, a revelatory case, or a longitudinal case (Yin, 2003).

In this case, the research focuses on inclusive socio-technical transitions and the role of intermediaries in such process. The case study focuses on the transition from a female-based contraceptive socio-technical system to an gender-inclusive contraceptives socio-technical system and the role of a network of intermediaries in such process. This is thus a study case that is *representative.* Although the research is somewhat unique, as the literature on socio-technical

transitions is not focused on inclusive innovations but on sustainable innovations, the case study is not. It has characteristics of a representative case study because a network of intermediaries acting to push the diffusion of an inclusive innovation is not a unique situation (Yin, 2003).

As a next step, the data has to be entangled and analysed, for the case study to reflect the research. After laying down the purpose of the research, the theoretical framework, the unit of analysis, and the methodology, Yin proposes to refine the criteria for making sense of the findings (1994, p.20). A *thematic analysis* offers a course of action to make sense of the data collected in a way that is systematic, comprehensive and coherent (Ritchie and Spencer, 1994). Ritchie and Lewis recommend 3 stages for a complete interpretation of the data: familiarisation with the data, drafting initial interpretation and identifying themes, and conceptualisation and mapping (2003). Some level of interpretation intervenes at all 3 stages, although at the first stage, it remains essential to set aside *a priori* understandings to ensure that at the second and third stage, the themes and conceptualisations stem from the data and not the researcher's personal ideas about the data (Ritchie and Lewis, 2003). The idea is that the interpretation behind thematic analysis should always follow the direction from science to arguments.

The analysis, following this framework, will start with descriptive accounts of the findings as well as some initial interpretations. This will help set out the prima facie interpretations of the participants as to what role they assume and barriers they encounter in scaling up inclusive solutions to implement socio-technical transitions and answer RSQ2.
These initial interpretations will hopefully support or lead the research to potential ties, relations and hierarchies with other themes and eventually a typology to answer RSQ3 and set out solutions to overcome the negative forces intermediaries encounter.

IV. Case study analysis and discussion

Presentation of the case study

The question of the inclusion of men in contraception has existed since the 'contraceptive revolution' of the 1960s (Lincoln & Kaeser, 1988). When the pill was introduced as a disruptive innovation and at that point, everything seemed possible and in the 1970s, experts were committed to investigate the possibility of male contraception (Steinberg, 1980). The 1980s marked a realisation that this revolution was a failure in terms of inclusion: there was no 'male pill', no reversible sterilant, no vaccine available, … (Lincoln & Kaeser, 1988). Only 8% of expenditure for testing contraceptive methods were dedicated to male methods (Atkinson et al., 1986). What had happened? Several barriers have been recognised.

Regulations, policies and overall political climate have been blamed, regarded as 'anti-family planning' or overly restrictive concerning the safety and efficacy of contraceptive devices (Atkinson, 1986). These regulations, in turn, have affected the possibility of financial commitments as the time and testing requirements were too consequent and have called into question the financial interest of continuing research (Atkinson, 1986). The fact that male contraception was not well culturally perceived by society, and thus potential users, did not help the financial viability of the project (Eberhardt et al., 2009; Oudshoorn, 2003; Van Wersch et al., 2012). Cultural elements like gender bias have been cited as major barriers as well since the 1970s. Boria-Berna specifies that there is a 'contemporary orientation toward making women responsible for birth control' (1972). Veerhusen talks of contraception as a 'female province' and asserts that the arrival of the pill has institutionalised that approach (1974). From thereon, the responsibility was on women (Luker, 1975). Science has taken a approach on contraception based on the premise that women are better 'contraceptors' because they are the ones who become pregnant, an approach that Luker describes as a 'social definition', not a scientific definition (1975).

More recent work shows that the subject is still present and presumably, these barriers – regulative, institutional, cultural, financial –, are also very present. Soufir mentions the lack of investment in the pharmaceutical industry (2012), Ventola demonstrated a clear gender bias or 'gendered representation of contraception' (2014) and when comparing England and France, she revealed a striking cultural influence in these decisions (2016), and many still raise the question of higher

expectations in terms of efficacy and side effects for contraceptive methods for men than for women (Liu et al., 2010; Soufir et al., 2011; Walker, 2011; Dismore et al., 2016; Amoureux et al., 2018).

However, in France a network of organisations and individuals has been shaping up these last few years and has been reinforcing the last five years. They have re-introduced the question of inclusive contraception with the development of thermal male methods, like the ring or the underwear, both based on a process called 'Thermal Male Contraception', or through table discussions, external events and workshops. Their work is now resonating in neighbouring countries, like Belgium and the network is ever-growing.

Analysis of the results

The previous sections of the research have brought to light the socio-technical transitions as a societal embedding process, as well as the role of intermediaries in such process. The first part of the analysis of this case study will thus explore these intermediaries' work in supporting and promoting this transition towards an inclusive contraceptive treatments, keeping in mind the definition of 'inclusive socio-technical transitions' as well as the framework embodying the MLP as societal embedding (RSQ1).

The second part of the analysis will delve into the positive and negative forces of the five societal dimensions of societal embedding, as experienced by the intermediaries (RSQ2), before moving on to the discussion of the case study in order to explore applicable solutions to these forces (RSQ3) for intermediaries to maximise their potential.

It should be reminded that the data presented here may not represent the entirety of Belgian and French intermediaries acting for an inclusive contraceptive system.

Part 1: The network of intermediaries

RSQ1: How are intermediaries internally organised in the implementation of socio-technical transitions?

To answer the first sub-question of the research '*How are intermediaries internally organised in the implementation of socio-technical transitions?*', the case study will be analysed to explore what elements influence the organisation of intermediaries in the transition towards inclusive contraception, and thus their role. They will first be classified according to Kivimaa et al.'s typology of intermediaries, which will provide an introductory picture of the members of the network and allow some initial interpretations of the data to be drawn (2019). They will then be classified according to their ties with other network, thus establishing the network of intermediaries. After that, the timeline of the actors' involvement in the socio-technical transition will be highlighted. These steps will allow some elements to stand out and initial interpretations will be drawn.

Classification according to their level of activities and motivations

After carefully identifying their main goals, level of independence and/or neutrality, as well as the locus of their activities, i.e. at the regime-level, niche-level, or 'in-between', the participants were categorized by their main trends, as seen in Table 3.

1. The regime-based transition intermediaries

Of the 11 participants, 4 are regime-based transition intermediaries. They were classified as such because they are all part of the dominant regime, participating in the day-to-day activities, but they are all committed to change (Kivimaa et al., 2019). They are not neutral, and have a clear interest in playing a part in the diffusion of male contraceptive methods (Kivimaa et al., 2019).

- For example, the *Fédération Laïque de Centres de Planning Familial*, or Secular Federation of Family Planning Centres (FLCPF), as well as the *Fédération des Centres de Planning Familial des Femmes Prévoyantes Socialistes*, or the Federation of Family Planning Centres-FPS (CPL-FPS) work with the regional governments of Brussels-Capital and Wallonia, and their work is dedicated to the promotion of health and sexual, affective and sexual life education, colloquially known as 'EVRAS'. They manage and coordinate their network of family planning centres by informing them through reports, workshops, and other internal events. They also do 'external work' which benefits the centres by organising awareness raising events or campaigns, lobbying and advocacy. Their involvement in inclusive transition is through existing institutions, through the mainstream channels, but they are mandated by their centres to inform them about innovations in their field and coordinate potential transitions.
- *Sips* is a family planning centre for young people, affiliated to the FLCPF. As such, their activities are also located at the regime-level, but their commitment to reflect on inclusive contraception, explore the options of male contraception and build relations with other actors with a view of implementing change places them at the regime-based transition intermediary position.
- *Femmes et Santé* is also navigate the dominant regime as it is mandated to promote women's health and are funded by public grants to that effect. Their objective, however, is to reflect on the overmedicalization of women's lives and the gendered health norms. There is thus a natural alliance to the movement towards inclusive contraception and the diffusion of male contraception.

2. *Niche intermediaries*

One other organisations were classified as 'niche intermediaries'. These intermediaries operate at the niche-level as they intermediate between local projects, interact with other niche actors or regime-level actors (Kivimaa et al., 2019). They are not neutral but have a clear interest in advancing a particular technology or niche (Kivimaa et al., 2019).

- For example, the *Association pour la Recherche et le Développement de la Contraception Masculine*, or the Association for Research and Development of Male Contraception (ARDECOM), is a clear example of what Geels and Deuten classify as intermediaries (2006). They are part of a niche and are committed to creating a network around male contraception with other actors at the niche-level, but also with regime-level actors like medical professionals' associations. They also organise their work around the three key activities suggested by Geels and Deuten: knowledge aggregation, networking and coordination (2006).

3. *User intermediaries*

The 6 remaining participants can be found in the 'user intermediary' category. User intermediaries are 'brokers' (Kivimaa et al., 2019). They are brokers in the sense of 'negotiators' or 'translators' of information, in the interest of the users. They negotiate and sometimes create pressure groups, they translate the information of a technology to users and they build demand.

- *Thomas Bouloù* are a men's group, initially created as a support group for male contraception and a discussion group about ways of changing gender relations. They have evolved to become more important within the network and now have added distribution-based activities, manufacturing and distributing contraceptive underwear themselves, to their information-based activities – an irregularity in the typology that will be addressed later.
- *Boulocho* and *Dr Kpote*, are solo actors, but their defining trait is that they are brokers of information. They also connect people, and do a lot of communication work, but at the heart of *Boulocho*'s mission is information sharing; going straight to the source of the information, doctors and users who developed and used the thermal method to users. *Dr Kpote*'s work is also focused on information sharing, but with a twist. They are first and foremost an instructor or facilitator in sexual education for young people, creating a space for discussion about the inclusion of men in contraceptive decisions and male

contraception, but also takes part in communication work and has ties with other niche-level actors.

- *FEMMES Prod* is an association which started their activities around a documentary on the contraceptive pill for women and the violence of the medical environment as experienced by women. It then grew to become a place of reflexion and information sharing around alternative ways of perceiving and using contraception through workshops and other tools of communication like podcasts and soon, an Instagram account.
- *Jemaya Innovations* is also a non-profit association that coordinates the knowledge on thermal male contraception between doctors and potential users. They use this knowledge and apply it in manufacturing the object and making it accessible to users. Their work also integrates coordination activities with other niche actors, but within their activist work, they express another side of the story: their collective action is as much an inclusive issue as it is *environmental* one.
- *Andro-switch* is, in a way, a special case. It is part of the niche, as they are developing their own technology, the Andro-switch ring. They have a business-like structure – Andro-switch is first presented on an internet site where the potential user can order and buy their ring – but aside from distribution and more importantly, their main goal is awareness and accessibility of both the information and the device for potential users, so that '*each individual can have a freedom of choice in the contraceptive journey*' (personal communication, 14 August 2019)

	Locus and interactions	**Motivations and interests**	**Participants**
Systemic intermediary	Regime-level, with niche-level and regime-level actors	Neutral position, dedicated and established as an intermediary, with an interest in supporting the transition	
Regime-based transition intermediary	Regime-level, with regime-level actors	Involved in the regime's activities but dedicated to change, from within and with the dominant regime actors	FLCPF (BE), Sips (BE), CPL-FPS (BE), Femmes et Santé (BE)
Niche (or grassroot) intermediary	Niche-level, with niche-level and regime-level actors	Aggregation of niche actors, development of a particular niche	ARDECOM (FR)
Process intermediary	'In-between', with niche-level and regime-level actors	Neutral position, established or employed as an intermediary	
User intermediary	'In-between', with niche-level and regime-level actors	Involved/activists in the users' interests, brokers of information	FEMMES Prod (BE), Thomas Bouloù (FR), Dr Kpote (FR), Boulocho (FR), Jemaya Innovations (FR), Andro-switch (FR)

Table 3. Transition intermediaries (own table, based on Kivimaa et al., 2019)

The classification of the intermediaries is captured in Table 3, a variation of Table 2. Some first impressions can already be drawn from this table, from the country of origin of these actors and the kind of intermediary they are.

Type of intermediary and activist identity

First, no systemic or process intermediary were identified. These two types of intermediary, in Kivimaa et al.'s typology, are the only types that are described as 'neutral' (2019, p.1069). This is not surprising as actors identified and selected in this study are all 'activists' to some degree, even though this was not a criteria of selection. This observation could be indicative of two things: the nature of the subject and the stage of the transition. Male contraceptive methods like TMC and more generally the topic of inclusive contraception are at a stage where it is such a 'niche topic' that only activists or 'outsiders' embrace it. There is also little financial gain in the short-term, and little interest as it is not yet in the public eye.

Type of intermediary and geography

Second, there is an apparent difference of locus between Belgian actors, annotated '(BE)', and French actors, annotated '(FR)'. While the majority of Belgian actors are located primarily at the regime-level, the French intermediaries are either niche intermediaries or user intermediaries, hence located at the niche-level or in-between levels.

Classification according to their ties: establishing the network

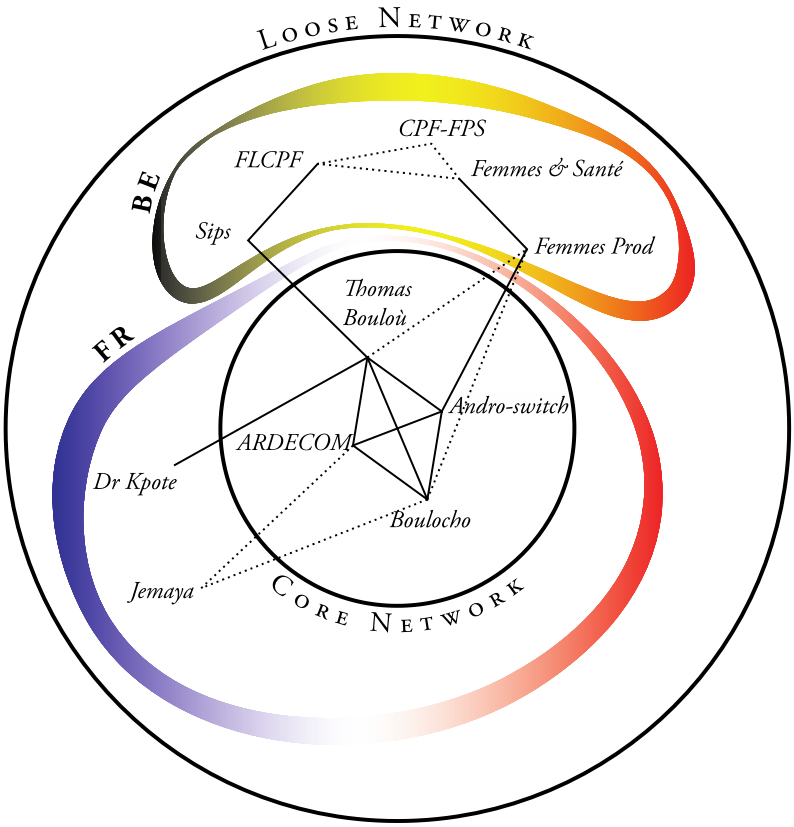

Figure 3. The network (own illustration from data)

From the partnerships, coordination efforts, and acknowledgments of other actors in the interviews, a structure of the network could be established. A 'core network' was identified, and it included Thomas Bouloù, Andro-switch, Boulocho and ARDECOM. Next, a 'loose network' was identified, which included the rest of the actors; Femmes et Santé, Femmes Prod, CPF-FPS, FLCPF and SIPS on the Belgian side, and Dr Kpote and Jemaya on the French side. The structure is depicted in here below (see Figure 3). It can be observed that : the 'core network' is located in France and the 'loose network' includes all Belgian actors. There is thus a relation to be investigated between the country of origin and the way the network is structured.

Timeline of the network

The timeline of the network was established from the interviews and is represented here below (see Figure 4). The timeline of the network refers not to when the actors started their professional

activities but refers to the moment in time when they started their activities in implementing the socio-technical transition towards inclusive contraception, although both moments can, and sometimes do, coincide.

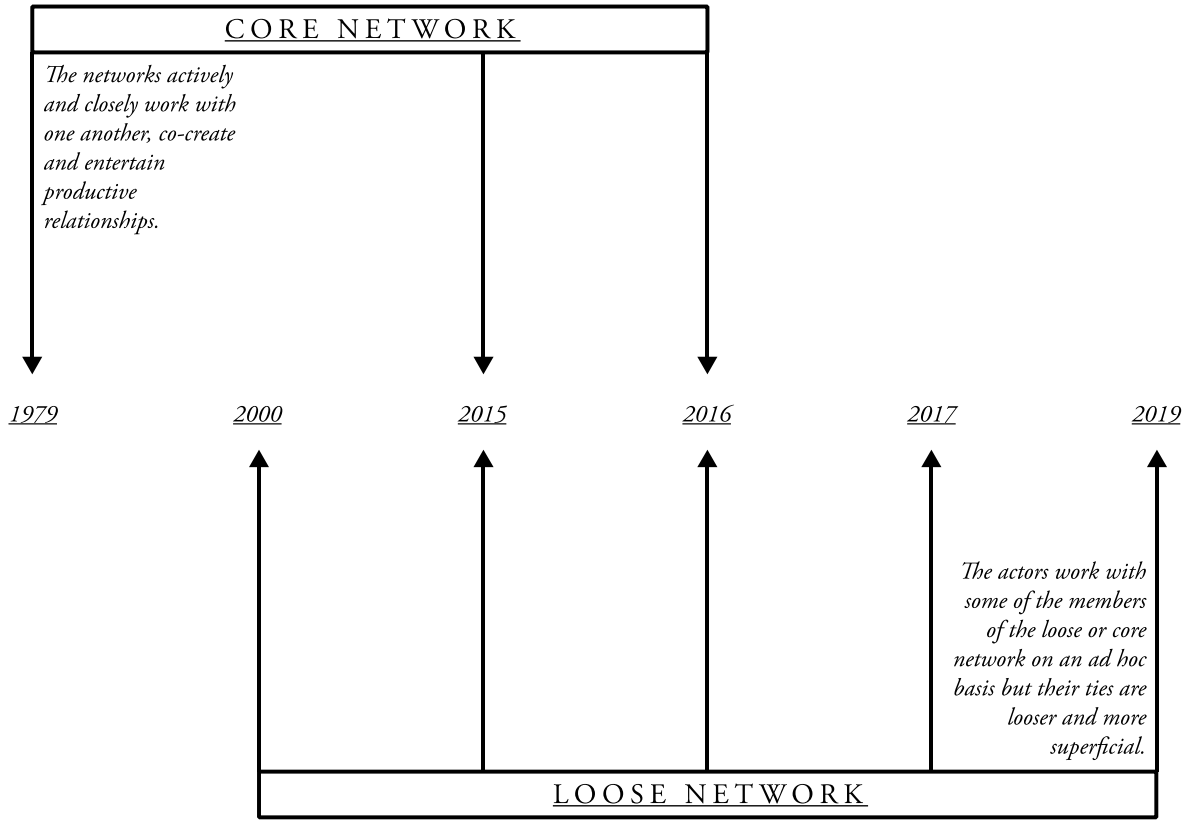

Figure 4. Timeline (own representation from data – ATLAS.ti)

ARDECOM was established in 1979 as a discussion group of men, in the aftermath of the contraceptive revolution, when feminist movements also allowed for gender biases to be addressed in several dimensions of the societal structure. They were thus active in the 1980s, but their activities then slowed down and their association faltered to near-extinction until it was revived in the recent years by a newly-found impetus. Femmes et Santé was born in the 2000s and the year 2015 saw the creation of Jemaya and Thomas Bouloù, already working on male contraception. Then, in 2016, Boulocho and Andro-switch have appeared on the map. When in tour in Belgium, Thomas Bouloù connected with the FLCPF and Sips, which then were confronted with the TMC for the first time, although the question of the involvement of men in contraception has been a constant issue within their organisations. In 2017, Femmes Prod started their activities and Dr Kpote met actors which 'refined' their knowledge and work on male contraception. The CPF-FPS

also conducted an awareness and information campaign in 2017, on the importance of sharing contraceptive responsibilities called 'Fifty-Fifty: Contraception concerns both partners' (personal communication, 14 August 2019; CPF-FPS, 6 February 2019).

Alignment of objective and strategies

	Alignment
Objectives (alignment)	4
Objectives (no alignment)	0
Strategies (alignment)	0
Strategies (no alignment)	6
Number of quotes	*10*

Table 4. Embedding in user environment (own table from data)

Table 4 shows 10 quotes on alignments of objectives and strategies that have been recorded. Participants were asked whether they could identify an alignment of interests and objectives with their peers. 4 quotes were positive while 6 were negative. When analysing the statements, however, it was observed that the answers which did not observe such alignment were not discussing objectives per se but strategies. Thus, a distinction was made between alignment of objectives and alignment of strategies. Out of these 10 quotes, 2 trends emerge. First, the objectives of the intermediaries seem to be aligned. Second, 6 quotes the strategies do not appear to be aligned.

Interpretation of the results

Next to their role in the transition, five variables were identified from these results: the type of intermediary, their identity, timing, geography, and their ties within the network.

Type of intermediary

The type of intermediary can be said to be part of the explanation for the difference in ties among the network's members. Their identities and identification of the problem were similar: there was a gap in the knowledge and accessibility of information and as users, they took an active part in

filling the gap, thus becoming user intermediaries. Boulocho, for example, conveys that since they met with other core members, they '*have tried to share information and share experiences and tools*' (personal communication, 18 July 2019).
This similar identity or type of intermediary, coupled with closer geography and timing could be all correlated with the strength of the ties of the network.

Identity: objectives and strategies alignment

On the one hand, the participants generally recognise they have similar objectives amongst themselves, they are 'on the same page' (Femmes Prod, personal communication, 15 August 2019). According to Boulocho, with the other core members, they manage to agree on a number of important points, such as '*not prioritizing contraceptive methods, letting users choose and set aside our preferences'*, on the importance of men's integration and viewing contraception as a means to that end; as well as on shared responsibility prior to any issues of abortion rights: '*in abortion, the man can quickly become an oppressor, and incite abortion when they do not want to. For us, it is also important to make people understand this and to say 'the solution is to take responsibility. On these issues, we can agree well.*' (Bouloucho, personal communication, 15 July 2019).
On the Belgian side of the equation, family planning centres and Federations appear to be 'all at the same stage' as the FLCPF put it: '*We are thinking about how to take ownership of the issue*' (personal communication, 26 August 2019). Femmes et Santé also recounts that there are more and more other associations and activist groups emerging, with similar interests and objectives, and thus '*we see that there are convergences and ideas that are integrating into society, among academics, in memorandums, advocacy, blogs, podcasts, on social networks ... Therefore, many citizen initiatives are also beginning to take place*' (personal communication, 20 July 2019).

On the other hand, there seems to be some discordances as to how they would like to implement their objectives. First, the branding and terminology is very diverse among the core members (Femmes Prod, personal communication, 15 August 2019). Second, they may have similar interests but their priorities sometimes diverge. For example, family planning centres may pay particular attention to the activities of the core members but have their own limitations of resources and they are focused on health and reproductive, affective and sexual education, so Boulocho acknowledges that '*it may seem to us to be a lack of availability, but it is up to us to give ourselves more resources rather than to ask for planning to give more. So we see common interests with family planning, but other priorities'* (personal communication, 18 July 2019). Third, there is the issue of commercialisation and how

to approach it when there are many regulatory constraints and follow-ups with users to be monitored (Boulocho, personal communication, 18 July 2019; Andro-switch, personal communication, 14 August 2019). Fourth, there are also technical differences between the contraceptive devices: Andro-switch offers a ring and Thomas Bouloù and Boulocho offer underwear (Andro-switch, personal communication, 14 August 2019).

These differences have created division of approaches among them. Andro-switch recognises that these differences can slow them down (personal communication, 14 August 2019). Despite some opposing views, it can be observed that they still do cooperate and create partnership.

Ties in the network

The ties between the intermediaries, their relationship, the communication between them, the partnerships as well as the strength of their ties influences how they form their identity as well as the type of intermediary they become. These ties can also influence the geographical elements, like moving their centre of affairs, like Andro-switch moving to Brussels, supported by Femmes Prod's own network (Femmes Prod, personal communication, 15 August 2019). They can also influence other actors' coming into existence or participation in the transition by making contact (timing).

Timing

The timing element has a clear influence on the ties in the network. From this timeline, it can be observed that the interest around inclusive contraception has been building up very recently and the movement was structured very rapidly. In 2015-2016, the user intermediaries which are part of this core network, namely Thomas Bouloù, Boulocho and Andro-switch, have arose. During these times, ARDECOM, an existing structure and the fourth member of the core network, was revitalized.

The timing also has affects their identity and the type of intermediary they become. When they start their activities in the context of the socio-technical transition, they will be confronted to certain issues existing at that point in time. For example, in 2015-2016, when the user intermediaries in the core network started, there was not a lot of other actors to turn to. As users themselves, they thus recognised there a gap that needed to be filled and organized their work to become user intermediaries. For example, Andro-switch recounts: '*I responded myself to my need by*

creating my tool. It started like this, and now I'm sharing this tool by making it accessible' (Andro-switch, personal communication, 14 August 2019).

The emergence of the French actors before the Belgian ones, coupled with the geographic component, can also partly explain the tightest relations existing among them, thus forming the current 'core network'.

Geography

The geographic location of an actors has been described as influencing the moment in time when they are first reached by an information or another actor. For example, when Thomas Bouloù organised tours in Belgium, that influenced when the Sips and the FLCPF started their reflexion around male contraception (personal communication, 7 August 2019; personal communication, 26 August, 2019). It cannot be excluded that geography has some influence on identity developed and on the type of intermediary the actor can become. It was demonstrated that most user intermediaries were French, while regime-intermediaries were Belgian. The reason behind is not clear, but it the following can be postulated: the activities of the core network have stimulated the interest of other actors which were geographically more remote (and hence later on), which were already active organisations or individuals. As these events have happened later on, this could explain why the loose network incorporates the Belgian regime-based transition intermediaries. They are regime-based because they existed prior to their contact with the topic at hand, and then they endorsed the role of transition intermediaries, rather than being mandated to that effect. The identification of a 'gap' causing users or groups becoming user intermediaries had not happened yet in Belgium, until Femmes Prod, in 2017: '*My goals are raising awareness and giving all weapons for informed choices. It's a bit of a way to overcome a gap that I experienced. I would have liked that*.' (personal communication, 15 August 2019).

Geography is also a big influence on the ties of the network. The French actors are closer to other French actors and Belgian actors are closer to Belgian actors, both geographically and socially.

Interrelation

It was demonstrated that the concepts of timing, geography, ties in the network and identity and type of intermediary are all interrelated. What can be concluded here is that these six elements, identified through the analysis, are correlated. The importance of each variable cannot be quantified from the data, but it can be established that they all influence each other, and in turn influence their role in the transition and the structure of the network.

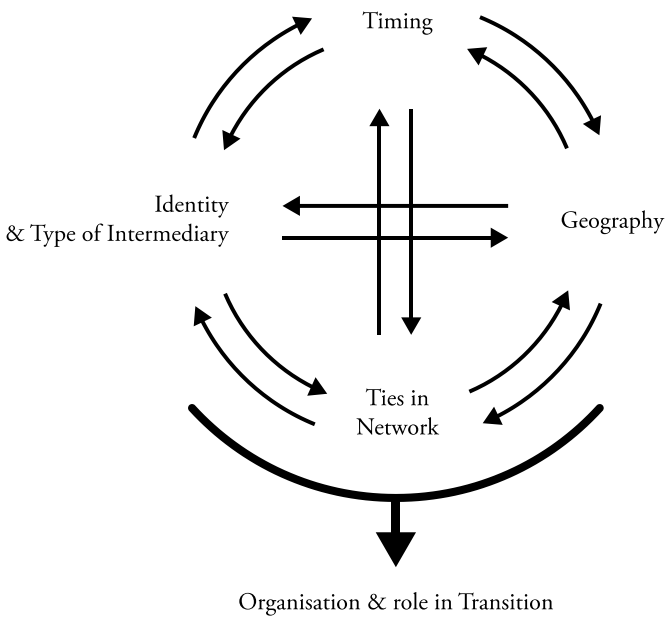

Figure 5. Formation of organisation and role of intermediaries (own illustration from data)

The intermediaries' roles and organisation in the socio-technical transition to inclusive contraception systems

The role of intermediaries in transitions is qualified by the variables mentioned in Part 1. It is influenced by geography, timing, their ties to the network and the type of intermediary.

It is also not just 'one' variable which plays a role, but sometimes it is the combination of two or more that can make a difference. In the case of Andro-switch, it was both the geographic

remoteness of any male contraceptive solution and their own identity which prompted their involvement (personal communication, 14 August 2019).

It is also dependent on whether the variable is a positive or a negative force. For example, a geographically close or remote location can be a positive or negative force, just like strong ties with an existing network can allow for innovation development or on the contrary, it can be a barrier to change because of path-dependency. For example, the FLCPF is an intermediary which already exists within a network of family planning centres and '*there are power conflicts*' and if an novel idea or method is introduced 'some centres are not going to want to' (personal communication, 26 August 2019).

So what influences the role of intermediaries and how they organise amongst themselves? From the data analysis, variables were identified and were concluded to be interrelated. There interrelated variables are decisive as to how involved these intermediaries are in the process. Where they are, when they start, what relations they nurture, as well as what defines them will play a part in their involvement.

It should also be noted that overall, most of these intermediaries are still very young and their role is still evolving, their relationship are still growing, and the network in itself is ever-changing. Most of their work is inscribed in the future. The FLCPF is organising a symposium on 'Contraception and Voluntary Termination of Pregnancy (VTP): look for the connection' on 26 September 2019 which will bring together a great diversity of actors (FLCPF, 2019); the Sips is organising multi-disciplinary meeting in January 2020 on thermal male contraception (personal communication, 7 August 2019); Andro-switch is looking to expand their network to the United States and Belgium (personal communication, 14 August 2019); Thomas Bouloù are re-focusing their work on information sharing (personal communication, 15 July 2019); at Femmes Prod they are developing tools and workshop to present inclusive contraception to couples, they are about to release a documentary and are also working on an Instagram series, which could bring attention to male contraception to a new public (personal communication, 15 August, 2019); and the others are working every day to make new connections and develop inclusive contraction systems.

Part 2: Analysis of the societal embedding of inclusive contraceptive methods in external environments

RSQ 2: What are the positive and negative forces experienced by intermediaries in scaling up inclusive solutions and stimulating socio-technical transitions?

In the literature review, in order to complement the MLP and these dynamics between technology, society and different domains, the notion of *societal embedding* was suggested. As discussed above, Kanger et al. focused on understanding technological diffusion as a process of societal embedding (2019). They found that the diffusion of a technology can be viewed as affecting different societal domains or 'environments', namely the embedding in the business environment, cultural embedding, embedding in the experts (or transnational) community, embedding in user environments, and regulatory embedding (Kanger et al., 2019, p.49-50). It also proposes that there are not simply 'barriers' or 'opportunities' arising from one domain but the adoption of technology is a process in a certain environment that exerts a certain force, positive or negative.

It was also posited that these five domains or environments can complement the MLP, as a socio-technical transition considers a co-evolutionary change from several systems, or domains, as well as a co-evolutionary change in technology and society (see Figure 2). Societal embedding explains these phenomena by considering that a certain technology is 'diffused' or 'instilled' into these five societal domains.

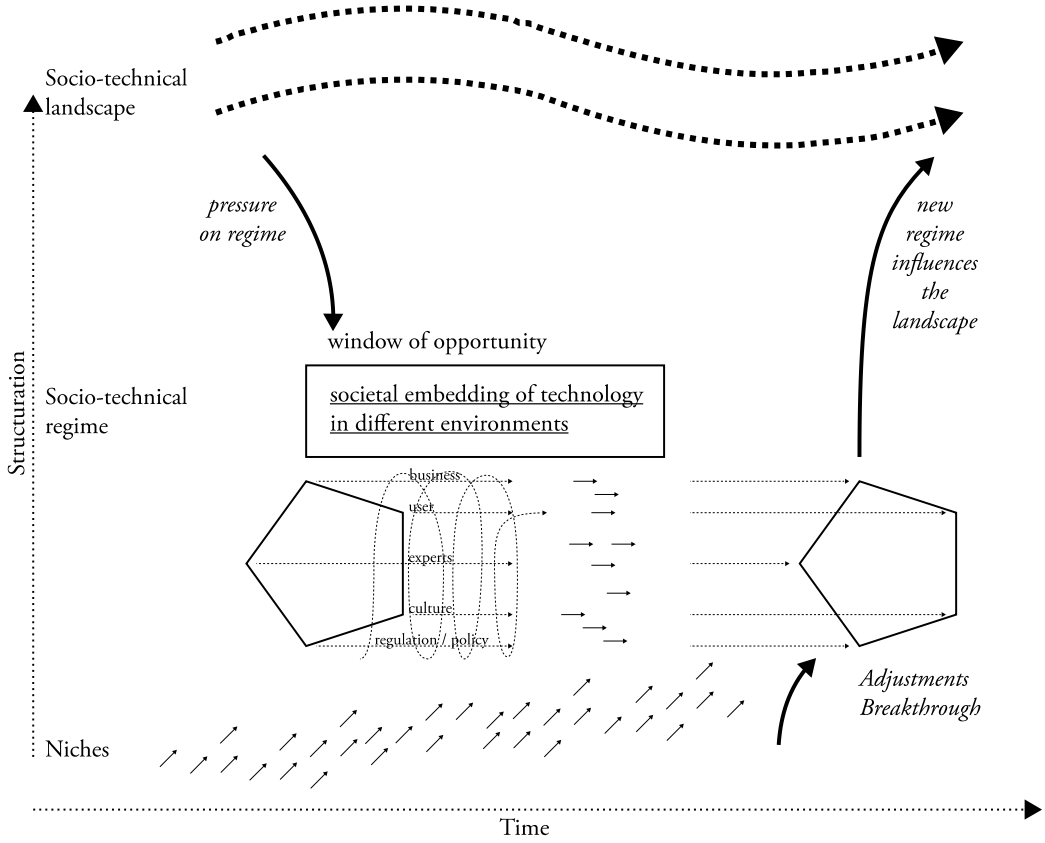

Figure 2. Socio-technical transitions as societal embedding (own representation, adapted from Geels, 2002, p.126; and Kanger et al., 2019).

This adapted framework will be used in order to answer the second research question '*What are the positive and negative forces experienced by intermediaries in scaling up inclusive solutions to implement socio-technical transitions?*'. Each external environment will be analysed to determine how this force, positive or negative, puts a pressure on the regime and the inclusive transition, and thus what barriers and opportunities intermediaries face in their day-to-day activities, i.e. scaling up inclusive contraceptive solutions (see Figure 2).

Embedding in user environments

In this case, it is clear that from the perspective of the participants, non-barrier male contraceptive methods, like TMC or even sterilisation, are not well integrated, and even not integrated at all, which suggests that user environments are negative forces (see Table 5).

	Embedding in user environments
Evolution	7
Regression	0
Not integrated	8
Not well integrated	11
Somewhat integrated	0
Well integrated	1
Very well integrated	1
Number of quotes	*22*

Table 5. Embedding in user environment (own table from data)

A gender relations issue

Out of these 19 quotes referring to a negative force, 9 were referring to a gender bias or the lack of inclusivity of men in contraceptive decisions. It's the usual '*it's a women's issue*' argument (Dr Kpote, personal communication, 18 July 2019 ; CPF-FPS, personal communication, 14 August 2019), '*Women are assigned contraceptive responsibility and men are socialized not to worry about contraception*' (CPF-FPS, 14 August 2019). The idea is that while women undergo a long and difficult contraceptive journey, which is considered a 'burden', and it is very integrated that men 'stay on the side-lines' (Boulocho, personal communication, 18 July 2019). Because of their own sensibility to the issue, and sometimes because they encounter difficulties of their own, women are considered a very valuable channel of information towards the diffusion of male contraception (Boulocho, personal communication, 18 July 2019). In the same way as Kanger et al. extend the user environments to 'non-adopters' (2019), Boulocho calls them 'potential users' (personal communication, 18 July 2019). However, they themselves have difficulties going beyond this 'contraceptive norm': '*even when they are interested, there is a need to reassure themselves about the effectiveness of the methods, the need to entrust this responsibility to their partner, the difficulty of asking their partner to get involved, ... They have greatly integrated this male privilege and they have enough trouble questioning it*' (Boulocho, personal communication, 18 July 2019). Women Prod notes that women have integrated this idea:

'*Women impose a lot on themselves, and find it much harder to get into their head that if a man could impose that on himself too*' (personal communication, 15 August 2019). In their experience, women are worried about the burden that can be imposed on men, possible side effects or discomfort, while '*women wear contact lenses or a bra all day long (…), and beyond that, they take hormones every day*' (personal communication, 15 August 2019).

Information

The lack of societal embedding was also correlated to the lack of information in 4 quotes. Sips have the impression that it is not integrated, but users should not be blamed, '*it is the lack of information that prevents this integration; it is not something that is available, unless people ask themselves the question and do the research.*' (personal communication, 7 August 2019). Femmes et Santé considers that there is a general knowledge gap on contraception in the user environments (personal communication, 20 July 2019). Dr Kpote mentions that the lack of information is also very dependent on the socio-economic environment (personal communication, 18 July 2019), and Thomas Bouloù also takes the analysis further and links the lack of knowledge of the subject to the 'gendered structure' where men simply do and mimic what they believe other men do (Thomas Bouloù, 15 July 2019). Thus, if it is not 'manly' in the collective imaginary, most men will not take the extra step look for other ways or for additional information, and the lack of access of information and the lack of reach for information could thus also be linked to gender structures. Femmes et Santé have also note that '*family planning centres are still frequented mainly by women'* (personal communication, 15 August 2019), which relates to both gender and information issues. The gender bias in going to family planning centres also bars men from accessing the information they could share with them, and/or because of the lack of information and thus awareness, they might not have the reflex or habit of going to family planning centres.

Integration and evolution

From 7 quotes, there is an indication that the situation is not static, and the process of societal embedding is evolving. Most the evolution is identified as the increase of interest and rate of approval. '*When I started, people didn't really know what it was, it was weird, but now we went from that, to enthusiastic approval*' (Andro-switch, personal communication, 14 August 2919). When doing street interviews, Thomas Bouloù also notices a growing interest: '*we can talk with men and most say that if it is effective, they are willing to do something and show interest*' (personal communication, 15 July 2019). Boulocho considers that there is an increase not only a question of interest as users but also in the

broader question of the development of male contraception in general (personal communication, 18 July 2019). Femmes et Santé frames this evolution within the broader #MeToo movement and the fact that '*society is rethinking consent (…), not only in sexual intercourse, but also in contraception*' (personal communication, 15 August 2019).

However, this growing interest is not necessarily matched by increasing numbers of users, or at least not yet. '*People are happy that it exists, but they don't necessarily act on it*' (ARDECOM, personal communication, 1 July 2019). This reluctance comes from both men and women, according to Boulocho, '*women are more familiar with the constraints of contraceptive burden*' so are complacent and men are ' *in a comfortable situation and leave it to their partner to take care of contraception*' (personal communication, 18 July 2019).
The numbers are still very limited but are multiplying: '*vasectomy numbers are going up in Belgium*' (FLCPF, personal communication, 26 August 2019), '*less than 50 people per year*' for Jemaya (personal communication, 3 July 2019), '*150 and there is more and more demand*' for Thomas Bouloù (personal communication, 15 July 2019), and Andro-switch considers that '*in terms of users, there are almost as many people who wear the ring as people who wear the underpants, in only 6 months. It's a curve that doubles pretty much every quarter, so it's going to go very fast.*' (personal communication, 14 August 2019).

Conclusion

The results are prima facie mixed, but they paint a rather consistent picture. The basis of the societal embedding in the users' environments is rather limited but is not a barrier per se, as it is evolving. It thus cannot be said to be a negative force, but rather a **positive force with potential and room to grow**. In fact, for the converted user, the new technologies in TMC are well integrated (ARDECOM, personal communication, 1 July 2019), and '*societal integration is very strong at the individual level, (…) there has been a real shift in consciousness*' with regards to contraceptive methods that are inclusive, effective, hormone-free and natural (Andro-switch, personal communication, 14 August 2019).

Embedding in the business environment

	Embedding in the business environment
Evolution	6
Regression	0
Not integrated	9
Not well integrated	5
Somewhat integrated	1
Well integrated	1
Very well integrated	0
Number of quotes	*22*

Table 6. Embedding in the business environment (own table from data)

At first glance, non-barrier male contraceptive methods are not very integrated in the business environment, with 14 quotes finding them 'not integrated' or 'not well integrated' and only 2 seem to suggest a degree of integration. The societal embedding in the business environment thus seems negative.

HMC and TMC: loss of market share and profits

First, the difference between the positive and negative results can be explained by the difference of the method that is considered. The two positive quotes referred to hormonal male contraception (HMC), as opposed to thermal male contraception (TMC). The participants seemed to consider the embracing of hormonal male pills by pharmaceutical companies more likely than thermal methods, which are much more cost-effective for users and thus much less profitable for businesses (Femmes Prod, personal communication, 15 August 2019; Andro-switch, personal communication, 14 August 2019). Andro-switch recounts events at an experts conference, where pharmaceutical companies attended and presented studies highlighting hormonal methods but obscuring other existing and accessible thermal methods like the thermal underwear or ring, which are devices the user only has to buy once: '*they did not present any feedback on the fact that we can already*

deploy actions around methods that already exists… But no, they don't care because it's not interesting for them. Clearly, the pharmaceutical industry wants to keep buyers by offering them something where they have to go to the cash register monthly or more or less regularly' (personal communication, 14 August 2019). The view is that businesses are not interested in developing TMC because first, they would lose their market share on women's contraception and second, it would be less profitable than hormone-based methods (Sips, personal communication, 7 August 2019).

All in all, the loss of market share and profits were cited 9 times as obstructions to the support from the business environment, which is considered reluctant to take part in the development of male contraceptive methods, with perhaps the exception of hormonal methods.

Nonetheless, Thomas Bouloù considers that there is an opportunity to be seized by businesses since thermal methods, compared to hormonal methods, are much less complicated and resource-intensive to develop (personal communication, 15 July 2019). There is also the fact that some do not consider male contraception as a substitute for female contraception but as a complementary technology, but '*that view is not perceived by that community*' (Boulocho, personal communication, 18 July 2019l

Integration and evolution

These last few years, although generally speaking the business environment is not a supporting structure, the development market of TMC seems to be quivering (Thomas Bouloù, personal communication, 15 July 2019). Some experience solicitations from business players who want to explore whether there is a potential market to be exploited (Boulocho, personal communication, 18 July 2019), and others observe new business players starting to enter (ARDECOM), but they remain rare.

Conclusion: evolution conditioned by the evolution of demand

The observed evolution of the societal embedding in the business environment seems to be conditional. It is not a 'buoyant market' (CPF-FPS, 14 August 2019), but it is a conditional support, meaning that it will not be supportive until it will have to be. Femmes Prod describes this dynamic with the organic craze: '*At first they were not happy that the organic movement was coming, (…) but because there was a big demand from the public that stores had to adapt. It wasn't their business at first, and then they made it their business*' (personal communication, 15 August 2019). Thus like any other disruptive innovation, old systems are replaced with new adapted systems and '*if there is a real appropriation of*

the object by the public, there will necessarily be a reaction on the other side' (Femmes Prod, personal communication, 15 August 2019). Therefore, the societal embedding in the business environment is seen as very linked to the users environment, i.e. demand. It has the potential of making TMC accessible, but this possibility seems conditional the evolution of user environments (Andro-switch, personal communication, 14 August 2019).

Cultural embedding

	Cultural embedding
Evolution	5
Regression	1
Not integrated	5
Not well integrated	6
Somewhat integrated	1
Well integrated	0
Very well integrated	0
Number of quotes	*18*

Table 7. Cultural embedding (own table from data)

Again, the results seem to suggest that culture is more of a negative force, but to better analyse these results, a line should be drawn between Belgium and France.

France and the pro-natalist policy/culture

In France, the pro-natalist policy is very instilled into their history and culture and is often brought to the forefront. In fact, among the 6 French participants, 9 quotes about the pro-natalist policy were recorded.

This pro-natalist policy, described by ARDECOM. was implemented after the Great War, as a result of the high number of casualties: '*there was at that time great effort put on the accompaniment of women in motherhood. Family planning was originally called 'Happy Motherhood'. A lot of resources were put on family allowances, on childbirth assistance and everything revolved around women*' (personal communication,

1 July 2019). It is thus '*socially and culturally integrated that boys don't use contraception*' and this conservative culture also encouraged the idea that '*men are warriors and women are planners*', as expressed by Andro-switch (personal communication, 14 August 2019). There is thus a '*gendered culture*' where there no shared responsibility in couples but the responsibility of contracepting is put exclusively on women (Thomas Bouloù, personal communication, 15 July 2019).

Based on Ventola's findings when comparing England and France (2014; 2016), ARDECOM mentions the cultural difference with England, where a vasectomy is much more common than in France where only women's body is medicalized (personal communication, 1 July 2019). This medicalization of women's bodies goes back to the contraceptive revolution years, in the 1960s-1970s, where men were side-lined: '*there was an 'elimination' – and this is not said in pejorative terms – of men at that time. And so, right now, you have to do a lot of work to do for men to understand that they are concerned, that they are half the story to have a child, and (…) it's up to them to shoulder their responsibilities as women currently do*' (ARDECOM, personal communication, 1 July 2019).

Of course, France is a large country and the 'French culture' is not perfectly harmonised environment; having the space and being able to open up to these debates on gendered roles as well as calling them into question can differ according to the social, economic and cultural environment: '*(…) [with] an upper-middle audience, there will be fairly conventional discussions about contraception and access to contraception, and gender stereotypes. If I'm in a slightly more difficult suburb, where everyone knows each other and the social level is lower, it's going to be more complicated topics to tackle, very clearly. That doesn't mean people aren't informed, but it'll be more complicated to assert it in the group. So it's not as debated and discussed. It is a personal matter, and assertion is a difficult task'* (Dr Kpote, personal communication, 18 July 2019). It should thus be kept in mind that cultural acceptability and discourses can, and do, vary across France.

Dr Kpote also hints at a regressive state of the political discourse, as the freedom of speech on certain subjects like contraception does not enjoy the same space as it used to in the 1970s partly due to a '*big come-back of religion and more generally, of morality*' (personal communication, 18 July 2019). Per contra, Andro-switch notes that they went from a state of ignorance to a state of interest '*we get testimonials, and in 3 years, we went from "it doesn't exist, it's dangerous, don't do it", to "oh, but actually a lot of people do it, see, why not me*?' (personal communication, 14 August 2019).

Belgium: weaker negative forces

As the FLCPF puts it, in Belgium, '*we are in a country that is culturally divided in* two', and vasectomy, for example, is much more common in Flanders than in Brussels and Wallonia (personal communication, 26 August 2019). In any case, '*vasectomy is the only male contraceptive method used in Belgium*' (CPF-FPS, personal communication, 14 August 2019).

Regardless, the accounts from Belgian intermediaries were more focused on the evolution of the discourses and narratives. Femmes Prod specifies that although Belgium is a pro-natalist country where culturally the concept of family is protected, '*there are much less barriers here'* and *'there is much more openness (…) we are very similar, we have the same language... but it's not as bad, let's say*' (personal communication, 15 August 2019). The Sips figures that there has been some cultural legitimacy building up since the #MeToo movement: '*In Belgium, it seems to me that it is tune with the times, towards equality. We have to accept that men need a little time (…) but I think it's a good time for this kind of thing to happen*' (personal communication, 7 August 2019).

Conclusion

France and Belgium do not seem on equal ground when it comes to cultural embedding. While France has a long history of being restrictive and the culture constitutes a clear negative force, in Belgium, the discourse appears more open and optimistic. It could suggest that in Belgium, the natalist culture is less present, making it is a more fertile soil for male contraception to grow.

Regulatory embedding

	Regulatory embedding
Evolution	3
Regression	0
Not integrated	11
Not well integrated	5
Somewhat integrated	0
Well integrated	0
Very well integrated	0
Number of quotes	*19*

Table 8. Regulatory embedding (own table from data)

In this case, in 9 quotes, they consider laws, regulations and policies to be a 'barrier' or negative forces, and in 9 quotes, the legal uncertainty was referenced. Once again, to analyse the societal embedding of this domain, France and Belgium should be differentiated.

Legal uncertainty in France

The pro-natalist culture in France initiated a long history of restricting laws and regulations. Boulocho recounts the Act of 31 July 1920, '*a piece of legislation that forbade talking about contraception and abortion*' (personal communication, 18 July 2019). '*This law was repealed only in 1967*', with the Neuwirth Act (No. 67-1176) of 28 December 1967, authorising the use of contraception. The link to abortion rights is apparent, '*the right to abortion remains a fragile right, and it continues to be questioned*' (Boulocho, personal communication, 18 July 2019). Since then, the legal history of France when it comes to contraceptive means has consistently been 'restrictive', as was qualified by Jemaya (personal communication, 3 July 2019):

- On vasectomy: '*We have a 2001 law that deals with issues related to sexuality and regulates access to sterilization. Prior to 2001, sterilization was considered a mutilation. The medical community believes that reproductive functions and function must be preserved and that they must be preserved. Undermining*

this function is a mutilation. Even though it's changed in terms of the law, in practice it's still profoundly entrenched [in medical practices]. To illustrate this point, this 2001 law, even if it recognizes the right of everyone to access sterilization without conditions of age, number of children, agreement of the partner, doctors allow themselves to apply these conditions and the state has no control over that. These practices remain very much overdue. The law also imposes a 4-month cooling-off period, which is the longest cooling-off period available for any intervention.' (Boulocho, personal communication, 18 July 2019). '*When a doctor does not want to practice because of the conscience clause, he must give, by law, the address of someone else. But they don't. So, in the vasectomy, there is progress to be made*' (ARDECOM, personal communication, 1 July 2019).

- On abortion: '*As with abortion, there is a conscience clause and there are still practitioners who refuse to implement them*' (Boulocho, personal communication, 18 July 2019).

- On hormonal injections: '*As for the law, the "Androtardyl" – testosterones that are used for men that are lacking in testosterone and where there is no contraceptive recommendation – we use it for injections. What we are doing is a 'non-AMM' [marketing authorization] prescription. It is very restrictive, and we are dependent, by law and by the producing society, on these mechanisms*' (ARDECOM, personal communication, 1 July 2019).

This previous quote is referring to marketing authorizations (*Autorisation de Mise sur le Marché*, or *AMM)*, which are necessary for reimbursement on medication. Another type of authorization is the *Autorisation Temporaire D'utilisation* (*ATU*), which is a temporary recognition. These types of marketing authorization or temporary recognition, explains Thomas Bouloù, '*are requested most of the time by the industrialists who 'manufacture' contraceptive drugs or technical systems. But doctors do have the freedom to prescribe them. But in this case, there is no reimbursement by the 'security' and the doctors say and are very reluctant to prescribe 'outside AMMs' or 'ATUs'. (…) This system of marketing authorisation coupled with the responsibility of doctors is a real problem'* (personal communication, 15 July 2019). This system means that in practice, in manufacturing their own contraceptive technologies, in this case thermal underwear, they don't even know whether they have the right to do so or not (Thomas Bouloù, personal communication, 15 July 2019). There is a 'legal vacuum' existing in France (Dr Kpote, personal communication, 18 July 2019). This legal uncertainty is as restrictive as it puts these intermediaries in insecure and precarious situations when exercising their activities. Andro-switch explains that they were so apprehensive of being sanctioned for manufacturing the contraceptive

ring for other male users that they advertised their device as a sextoy (personal communication, 14 August 2019).

Legal uncertainty in Belgium

In Belgium, the situation is not as restrictive but is certainly as ambiguous: '*There is no law, everyone does what they want*' (FLCPF, personal communication, 19 July 2019). Male contraception does not appear anywhere in the law, not does vasectomy (CPF-FPS, personal communication, 14 August 2019), although it is fully reimbursed by social security (FLCPF, personal communication, 19 July 2019). In fact, the law does not perceived as a hindrance, but it is not a supportive force either: '*when tools will be read-made and available, the law will follow and frame what will already be put in place. In Belgium, and I also believe it is the case everywhere else, laws come after the events have taken place and have settled down*' (Femmes Prod, personal communication, 15 August 2019).

Conclusion: evolution conditioned by the evolution of user environments and culture

The issue, for Femmes et Santé, does not lay so much in the evolution of laws and regulations but in the real change in practices and behaviour, which have to be the catalyst, but '*in politics, (…) we don't have that time'* (Femmes et Santé, personal communication, 20 July 2019). The evolution and societal embedding in laws, regulations and policies is also appears to be conditional to change in user environments and culture. According to Andro-switch, '*societal integration at the institutional level is a hindrance, and it has not followed the ongoing change. It is normal, institutional change is very long. It's inertia. But this brake is not going to stay, the gears will be put in place and as time goes by, it will follow. Institutions are a reflection of the people'* (personal communication, 14 August 2019).

Embedding in the experts (transnational) community

	Embedding in the experts community
Evolution	4
Regression	0
Not integrated	7
Not well integrated	10
Somewhat integrated	1
Well integrated	2
Very well integrated	0
Number of quotes	*23*

Table 8. Embedding in the experts community (own table from data)

The participants identified 2 different types of what they considered to be 'experts' in the technology: medical professionals, like doctors, and family planning centres.

The medical professionals

Among the 23 statements, 17 quotes note that the societal embedding in the experts community is not integrated or not well integrated. Overall, the idea that the technology is not well embedded in the experts community was very much linked to gendered roles: '*We usually have the experts, (…) who are against male contraception, because they see it as the role of women and it is not up to them, men, to deal with it*' (ARDECOM, personal communication, 1 July 2019) and '*they are very marked by the idea of genders*' (Thomas Bouloù, personal communication, 15 July 2019).

Because of this gender bias, coupled with their focus on preventing abortions, the FLCPF says that '*doctors do not address male contraception*' (FLCPF, personal communication, 26 August 2019). Femmes Prod explains that they are prevented from seeing other contraceptive solutions that exist around hormonal female methods: '*If their goal is only to prevent a woman from going through an abortion,*

damage will be caused because they will not have considered things more holistically. So there is no questioning on the part of doctors, and this idea of male contraception and non-hormonal contraception is not received at all.' (personal communication, 15 August 2019).

This gender bias de facto also takes a toll on information sharing, continuing education and the development of research: '*There is a barrier deliberately put on the deployment of experts to validate the [thermal methods. There is the training put in place by the SALF, as continuous training for doctors, to offer them 2 hours where they were going to have the tools to support thermal contraception in an effective scientific and medical way. Well it never could get funding by the Ministry of Health, so they're going to stop it. The department said "no, it is felt that it is irrelevant and money is being thrown out the window with this training". Institutions are locked in a form of patriarchy.'* (Andro-switch, personal communication, 14 August 2019).
Because experts wear blinders and are locked in a patriarchal system, and Dr Kpote makes the point that while contraceptive underwear based on TMC have existed since the 1970s, it still looks like we 'discovered', while they have existed since the 1970s (personal communication, 18 July 2019). Thomas Bouloù supports this view in saying that: '*Most people who say they are experts don't know anything about it and they are very marked by the idea of genders (…). Experts are therefore sometimes a problem rather than a solution to the development of male contraception*' (Thomas Bouloù, personal communication, 15 July 2019). As a result, '*there is little scientific research in the field, which does not allow the development of male contraceptive methods*' (CPF-FPS, personal communication, 14 August 2019).

Along the lines of Femmes et Santé, which have been denouncing gynaecological and obstetrical violence for years (personal communication, 20 July 2019), Femmes Prod also explain the link between these gendered medical practices and violence: '*Among doctors, it is very discredited, very little known. As a woman, if you want to stop hormones, they look at you from head to toe and say, 'Well, if you want to get pregnant, keep going miss.' For male contraception is the same. You don't give it credit because there is no legal framework, and for a doctor, it's the only thing that counts. It's a shame for them that they don't see what's going on outside*' (personal communication, 15 August 2019). For them, the development is slow because '*we are so overwhelmed with fear because by doctors*' (Femmes Prod, personal communication, 15 August 2019)

There is some discordance in the results, as Jemaya describes the experts as 'partisan' to male contraception developments (personal communication, 3 July 2019) and ARDECOM also observe that there *is* some international recognition from the transnational community, as in international

meetings, Soufir and Mieusset, active researchers in HMC and TMC, are recognized by their peers (personal communication, 1 July 2019). This could suggest that the view that male contraception is not well embedded in the experts community could be more meaningful in the *national* experts community in France and Belgium than in the *transnational* experts community.

Family planning

Among the participants, 6 found that experts had to include family planning centres. In France, Thomas Bouloù found that they even though they do not always know about TMC, they are generally interested and want to find out more and do not constitute a hindrance, compared to medical professionals: '*family planning centres do not always know about non-barrier male contraception but they are interested. Doctors, they don't know either, or not well, and they're not interested*' (personal communication, 15 July 2019). The FLCPF, themselves coordinating 42 centres, seems to confirm these impression: '*There is awareness in the planning centres. The question is there and we are asking ourselves it. But we don't have the solutions, and they don't have the tools'* (personal communication, 26 August 2019).

Evolution

There has been some mentions of future steps, which suggests that societal embedding in evolving. In family planning centres, Femmes Prod mentions that some family planning colleagues will soon incorporate TMC into her presentations (personal communication, 20 July 2019).

In the medical field, the FLCPF says that research and awareness raising is continuing among the gynaecologists of Saint Peter in Brussels (personal communication, 26 August 2019), and Femmes et Santé reflect on the fact that although they still see strong resistance from doctors when asking them to apply cautious when it comes to gender issues in their practices, it is changing 'little by little' and now, for example, their work on denouncing gynaecological and obstetric violence is well integrated (personal communication, 20 July 2019).

All in all, apart from a few exceptions, the experts community is not a positive force and is mostly seen as a hindrance to developments.

Conclusion

After the analysis of each domains suggested by the societal embedding framework (Kanger et al., 219), an answer to the sub-question: *What are the positive and negative forces experienced by intermediaries in scaling up inclusive solutions to implement socio-technical transitions?*', should be discernible.

All the domains studied are exercising a negative force to some degree. What differentiates them is the potential of their evolution, as perceived by participants. The user environments was distinct among the other domains, as it was perceived as a potential positive force and catalyst, which could cause the other ones to follow. To summarize:

- The societal embedding in the users' environments is rather limited but is not a barrier per se, as it is evolving. It thus cannot be said to be a negative force, but rather a dim positive force with potential and room to grow.
- The observed evolution of the societal embedding in the business environment seems to be conditional to the users environment, i.e. demand.
- When analysing cultural embedding, the results suggested that in France the discourse was a negative force and in Belgium, the natalist culture being less present, the discourse was potentially a positive force.
- The evolution and societal embedding in laws, regulations and policies is also appears to be conditional to change in user environments and culture.
- The experts community was seen as a negative force, mostly seen as a hindrance to developments, and dependent on cultural change.

A visual representation of these results can be seen in Figure 6.

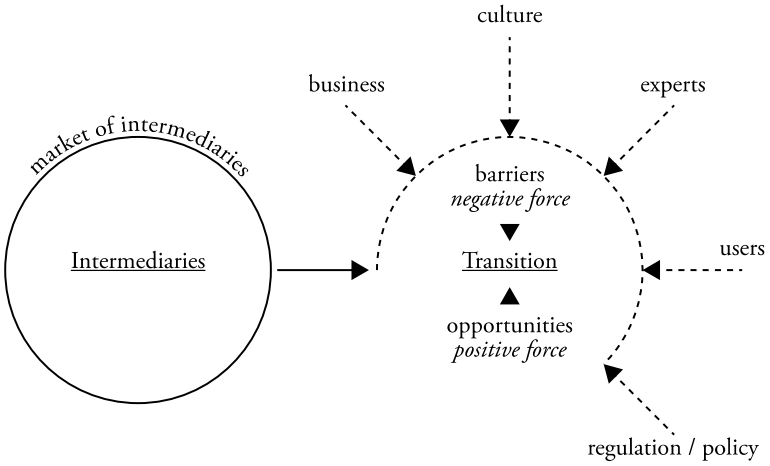

Figure 6. Positive and negative forces in socio-technical transitions (own representation)

In the face of these positive and negative forces, how can these intermediaries optimise their internal strengths to support the diffusion of inclusive contraceptive treatments? This conclusion leads to the next research sub-question: *How can intermediaries internally organise to overcome negative forces and ultimately stimulate a socio-technical transition?*

Discussion and establishing solutions

Sub-question 3: How can intermediaries internally organise to overcome negative forces and ultimately stimulate a socio-technical transition?

To answer the question '*How can intermediaries internally organise to overcome negative forces and ultimately stimulate a socio-technical transition?*', the research has established how intermediaries were internally organised and what external positive and negative forces they experienced. This section will attempt to find out how this network of intermediaries can use their internal strengths and organise themselves in order to optimise their role in the diffusion of inclusive solutions, in this case, inclusive contraceptive treatments.

Internal organisation	**External forces**	**Solution**
Type of intermediary (1)	Users (+)	*Coordinating facility or actor: an intermediary of intermediaries.* Coordinating intermediaries according to their type (1) and identity (2) Managing relations and information sharing among them, tracing progress, goals, targets, to manage external forces (+) or (-). Monitoring emergent actors and new information (3), (4), (5).
Identity (2)	Business (-)	
Ties (3)	Culture (-)	
Timing (4)	Regulations/policy (-)	
Geography (5)	Experts (-)	

Table 9. Solutions (own representation from data and discussion)

Intermediaries are characterized by their intermediary work, whether it is between actors, between technologies and between institutions (Van Lente et al., 2003). In a socio-technical transitions,

where all these dimensions shift roles and influences, their role is potentially catalyst. They can play a part in changes in several domains like the user environments, the business environment, the experts community, the formation of regulations and policies, and the formation of narratives and cultural legitimacy, because of their 'in-betweenness'.

However, as was illustrated by this case study, there is a 'market of intermediaries', and to optimize their activities, their relationships among them need to be managed as well. In developing a solution, different objectives were established in light of the case study:

1. Preserving diversity
2. Cultivating relationships and information sharing
3. Monitoring new developments (emerging actors, technologies and next steps)

1. Preserving diversity

In Part 1, the analysis of the process of organisation brought to light different elements: the type of intermediary (1), their identity (2), their ties within the network (3), timing (4) and geography (5).

The type of intermediary (1) and their identity (2) refer to the nature each intermediary, and their differences in types as well as diverging objectives and strategies were uncovered. To implement a socio-technical transition, the innovation should profit from the window of opportunity (pressure from landscape) and break through (Geels, 2002). What can a network of intermediaries with different *loci,* motivations, objectives and strategies do to optimise their role?

One way would be to harmonise their activities, objectives and strategies. However, in practice, this sort of enterprise would be very challenging to initiate, as the activist nature of these intermediaries and harmonisation are hardly compatible and whether it would profit the actors and the process is doubtful.

Another way of proceeding would be preserving the different types and identities. In fact, Hargreaves et al. found that diversity is a defining trait of niches, it is what makes them particularly dynamic and the diversity of project should be protected (2013). The 'market of intermediaries' should thus remain diverse and vibrant.

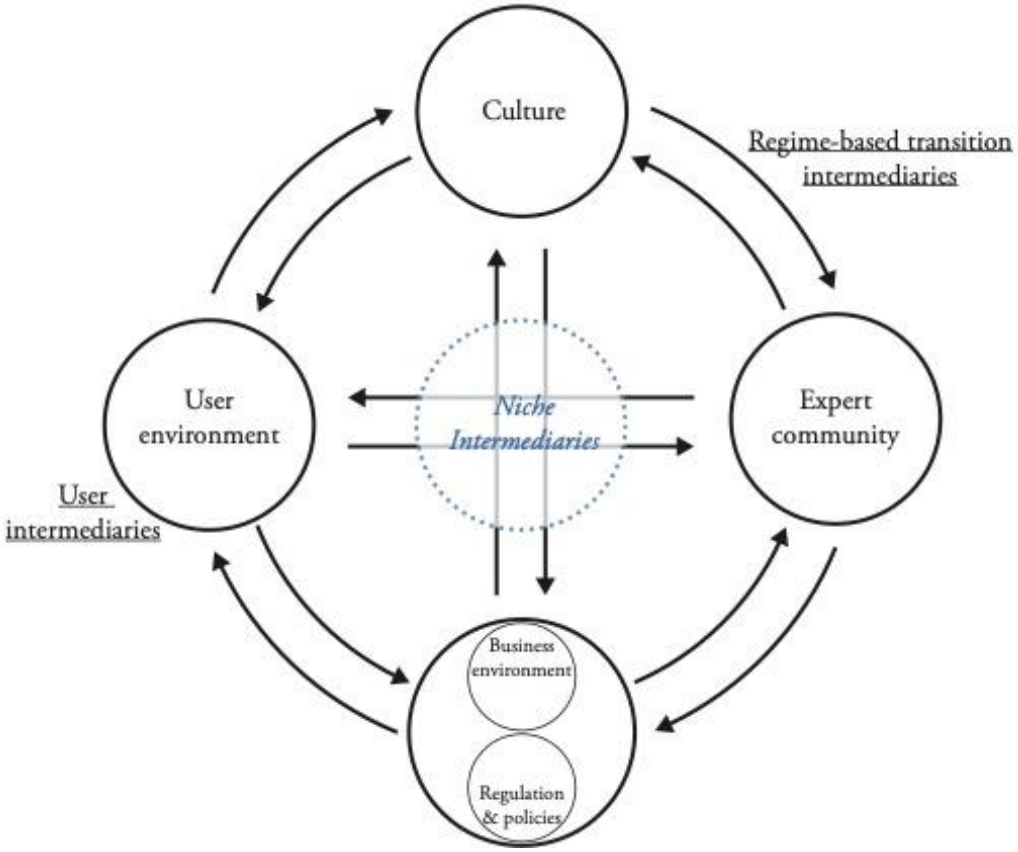

Figure 7. (own illustration, adaptation from the framework of Kanger et al., 2019 and typology of Kivimaa et al., 2019)

This diversity also serves the external forces they face and they all serve a role in the network. The type of intermediary they are can also be applied to the different domains analysed in Part 2. In this case, it is argued that user intermediaries have a particular role in cultural embedding and societal embedding in user environments; niche intermediaries are better placed to intermediate the societal embedding of user environments, culture and the expert community; and regime-based transition intermediaries are well disposed to operate in the business environment and at the policy level.

Societal embedding in the user environments, considered a catalyst by the participants, should be particularly nurtured. The integration of male contraception and thus inclusive contraceptive treatments in user environments is believed to be key in unlocking integration in the business and regulatory/policy domains, which will theoretically 'follow the demand' and 'frame what already exists' (Femmes Prod, personal communication, 15 August 2019). Building a demand and building acceptance among users is thus an essential part of the solution, and *user intermediaries* are defined by that goal (Kivimaa et al., 2019). Their role in this transition is therefore fundamental.

Regime-based transition intermediaries also have an important part to play as they are dedicated to change from within and with the dominant regime actors (Kivimaa et al., 2019). By changing the discourses within the institutions, they can have a great impact on cultural embedding, because as established institutions themselves, they have a bigger stage to voice their concerns, opinions and support to inclusive transitions. As in this case, culture was established as a negative force, a lot of resources need to be concentrated on building cultural legitimacy. This in turn could have a great impact on the experts community, also considered a negative force and dependent on cultural change.

Finally, *niche intermediaries* have a pivotal function as they aggregate niche actors, whether they are experts, businesses, policy advocacy or lobbying groups, or users. They have an important role in all aspects of the transition, but including in coordination with other actors and other intermediaries.

2. Cultivating relationships and information sharing

To maximise impact, coordination is key, and in that effect, cultivating relationships and information sharing within the market of intermediaries need to be given special attention.

Information and information sharing were one of the most cited phrases – 38 and 41 respectively –, it is evidently an important dimension to their work and their objectives. Coordination and the role of other associations are also essential elements, as they were associated with 26 and 42 quotes respectively. However, the way they organise their relationships and information sharing is on an *ad hoc* basis – no particular method of coordination and information sharing was identified – and it is argued here that they would benefit from organising these two dimensions, for more consistent contact among the members of the network, thus creating more partnerships and cooperation, as well as effective and consistent information sharing.

3. Monitoring new developments (emerging actors, technologies and next steps)

In Part 1, the intermediaries' ties within the network (3), timing (4) and geography (5) refer to the way the network was formed, and can be representative of the way the network can grow or be reinforced. When these elements coincide, they can results in a larger and stronger network, meaning more partnerships and more resilience. For example, it was demonstrated that the emergence of the French actors before the Belgian ones, coupled with the geographic component, could partly explain the tightness of the relations existing among them, and the formation of the

current 'core network'. These elements, in this case, have evolved organically, and sometimes coincidentally to eventually build a network. Cooperation between intermediaries is already taking place, but it is not methodically organised.
Developing and approach to monitor these variables could be beneficial – for example, monitoring of when, where, what type of actor is emerging and what ties with what actor are pursued – to build internal knowledge of the transition's state of evolution, awareness of other players in the filed or related fields, and eventually coordinate to build momentum and windows of opportunity.

Conclusion

The organisation of the network of intermediaries has been analysed internally in Part 1, and it is concluded that this organisation can be optimised to better support their role in the diffusion of inclusive solutions, in this case, inclusive contraceptive treatments. The solution in mind is one that has to preserve diversity, cultivate relationships and information sharing, as well as monitor developments, in other words a coordination instrument.
The format of this coordination instrument is outside of the scope of this research, but several options can be considered: in the format of an online platform or interface, regular meetings, or in the form of an individual or organisation.

Of course, such coordination instrument would require some time investment and financial resources. As these resources were reported as limited by all participants, some organisations are self-funded and others receive grants but all experience financial difficulties, regular meetings and funding an organisation would be difficult to implement in practice. In such case, online platforms or interfaces could be suitable solutions, time-efficient and not requiring too much financial investment, but the relational aspect of meetings or the work of an organisation or individual would be lost. It is thus a balancing act, but in any case, a higher level of coordination would be achieved and the work that is already done by the intermediaries would not be lost but optimized.

VI. Concluding remarks

Concluding remarks and future research directions

The first research sub-question asked '*how are intermediaries internally organised in the implementation of socio-technical transitions?*'. The process of the constitution of the network was retraced and variables were identified and recognized as being interrelated. It was concluded that these interrelated variables are decisive in the role these intermediaries take on in the transition. Where they are, when they start, what relations they nurture, as well as what defines them will play a part in their involvement.

The second research sub-question asked: '*What are the positive and negative forces experienced by intermediaries in scaling up inclusive solutions and stimulating socio-technical transitions?*. With the help of the societal embedding framework, five domains were analysed: the user environments, the business environment, cultural legitimacy, regulations and policies, and the experts community. Each of these domains were then determined to be positive or negative and this lead to the question of how intermediaries could face these external forces and thus to third research sub-question: '*How can intermediaries internally organise to overcome negative forces and ultimately stimulate a socio-technical transition?'*.

The research proposed an innovative way of studying intermediaries, with the combination of the MLP and the societal embedding framework, as well as the combination of transition studies and the concept of inclusivity. It asked the following research question: *How can networks of intermediaries reinforce their potential in scaling up inclusive solutions and stimulating socio-technical transitions?*

All in all, with the help of the case study, it was concluded that the market of intermediaries was disorganised as a network and needed intermediating. A coordination instrument was suggested as a potential solution, though the format depends on further variables – unmeasured, in this case. Although the configuration of this coordination instrument was not determined, three conditions were laid out. First, it should be designed to preserve diversity. Second, it should cultivate relationships and information sharing. Third, it should be designed to monitor new developments (emerging actors, technologies and next steps).

The idea behind this coordination would be to extend the knowledge aggregation in the network and applicability of the device. Intermediaries are knowledge-based entities, but they are limited in

their own context and can have a myopic view or system-thinking, which can prevent the development of technological 'low-hanging fruits'.

Areas for future research

In future research, further examination on ways to combine the concept of inclusivity to socio-technical transitions and more applications of inclusivity in the multi-level perspective would be interesting. Innovation processes can be biased towards implementing a solution that is not profitable to marginalized members of society, or the socially excluded. In sustainable transitions, the logic in the MLP suggests that the demand will inevitably prefer sustainable and efficient solutions (2002). But what about the solutions that are inclusive but where the demand is not sufficient because the marginalized portions of the population cannot have their voices heard? Inclusive solutions can be affected by this issue of 'too many niche projects' because they are not part of the mainstream 'regime', by definition.

Further research on intermediaries is also necessary, as many sides to the story remain to be uncovered, such as how coordination instruments in a market of intermediaries can be applied in practice. Their role in societal embedding could also be analysed further, as in this case, only user intermediaries, niche intermediaries and regime-based transition intermediaries were included in the typology developed by Kivimaa et al. (2019).

Lastly, an important take-away of this research would be for the literature on innovation and transitions to open the discussion in the literature to focus on both inclusivity and sustainability, as both aspects are important for both innovation policy development and human development.

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