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Meta-organizing Clusters as Agents of Transformative Change through 'Responsible Actorhood'

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ABSTRACT

How to organize clusters as local agents of transformative change, i.e. players that actively contribute to systemic sustainability transitions anchored in territories? We take a meta-organizational approach to the design of clusters for sustainability. We argue that achieving meta-organizational 'responsible actorhood' is a crucial condition for clusters to act as local agents of transformative change. Responsible actorhood allows to address the issues of lack of answerability, path dependency towards growth and labor resistance. Responsible actorhood involves 1) developing mechanisms to ensure 'meta-organizational accountability', 2) nurturing 'transformative mediated reflexivity' about technological ruptures and ecological performance in a public-centric approach and 3) enabling 'negotiated professional restructuring' to establish new knowledge processes at work. We contribute to the literature on clusters and STI policy, and to the meta-organization literature. Our work also has policy and practical implications for the design and steering of eco-industrial clusters.

Keywords: Meta-organization, eco-industrial clusters, sustainable innovation, actorhood, accountability, reflexivity, professionality

INTRODUCTION

Tackling grand challenges and ensuring sustainability transitions of our societies require deep, multi-level and systemic transformations of our production and consumption modes (Geels, 2002). Recent literature on transition studies calls for a new framing of innovation policies, centered on transformative change through local experimentations and deliberative governance processes (Schot & Steinmueller, 2018). The roles clusters can play in these multi-level system transformations for sustainability is generally implicitly downplayed, as they are considered outmoded policy instruments (Schot & Steinmueller, 2018). Yet, there is no one best way to sustainability transition. On the contrary, transition thinking argues that multiple actors, directionalities and pathways can have transformative change power at a system level (ibid). In addition, geographies of transition calls for a place-based approach of sustainability transition (Binz et al., 2020), which precisely requires investigating clusters. So, how can clusters provoke system level transformative change?

Clusters, a focus of science, technology and innovation (STI) policy in the 80s, incarnate the strategic choice of public policy to concentrate specific activities in a given territory (Castells & Hall, 1994). Initially, sustainability was not clusters' core focus (Martin & Mayer, 2008). This situation is however changing with the development of eco-industrial clusters (Cooke, 2011) and third sector or solidarity economy clusters and similar arrangements (Lemaître & Helmsing, 2012; Petrella et al., 2021; Saniossian et al., this volume). In this evolution of both clusters and STI policy, we still understand relatively little about the ways to organize and shape these important territorial players so they can contribute to sustainability transitions.

This paper makes the key assumption that clusters can be (re)designed to act as agents of transformative change for sustainability, i.e. as places of local experimentations and as

governance devices facilitating inclusive deliberation processes. We argue that one condition for this is that clusters achieve what we call "responsible actorhood". By responsible actorhood, we mean that clusters and more generally collaborative arrangements among organizations, or meta-organizations, 1) become organizational actors, i.e. they become externally perceived as actors (King et al., 2010), and 2) make active steps towards sustainability transformation. Developing a meta-organizational approach, we explore how to enact 'responsible actorhood' and produce such transformative change. This involves solving issues of answerability, path dependency to growth and labor resistance through 1) developing mechanisms to ensure 'meta-organizational accountability' towards stakeholders, 2) nurturing 'transformative mediated reflexivity' about technological ruptures and ecological performance and 3) enabling 'negotiated professional restructuring' to establish new knowledge processes at work. We thus contribute to more critical approaches of meta-organizations and responsibility discussions (Carmagnac et al., 2022).

THE ROLES OF CLUSTERS IN STI AND TRANSITION

Clusters constituted one of the main policy tools in the 1980s to foster R&D, innovation and entrepreneurship (Schot & Steinmueller, 2018). They were mostly designed to enhance competitiveness (ibid) and turned out to raise several governance issues (Cooke, 2001). While they have sometimes successfully triggered major disruptions in businesses, clusters and more generally the first and second frames of STI have been accompanied by growing inequalities, especially at the international level. According to Schot and Steinmueller (2018), these effects result from the very nationally anchored models of innovation clusters traditionally incarnate. Conversely, system transition, they argue, must involve a new model of innovation based on local niches and experimentations, on deliberative governance and on transformative change (ibid).

Three synergistic levels matter in system transition: a sociotechnical landscape which encompasses the macro-political economy, social values and culture ; a meso-level of socio-technical systems, called "regimes" with their institutions, rules and practices; a micro-level of niches were experimentations can take place (Geels, 2002). In the latter level, innovation can emerge and eventually displace incumbent, unsustainable regimes and produce transformations at other levels (Schot & Geels, 2008). In this perspective, we can assume that regions or territories, through clusters, can become spaces for local experimentation leading to wider change at the national level (Cooke, 2015).

Yet, clusters have not always been designed for sustainability (Martin & Mayer, 2008). But ‘eco-industrial clusters’ are increasingly being set up. In this specific kind of cluster, sustainable innovations can take various forms, from Product-Oriented, Flagship-Oriented, to Territory-Oriented, or Institution-Oriented (Kebir et al., 2017). They may thus contribute to develop social or environmental innovations for the transition. This kind of clusters presents two specific characteristics of social interactions: i) their members include professional groupings or associations gathering not only companies or research and education players but also NGOs, public authorities, citizens or consumers; ii) they are governed by new multi-scalar laws and regulations (ibid).

CLUSTERS AS META-ORGANIZATIONS

Clusters can be conceptualized as a specific type of meta-organization with a territorial anchorage (Berkowitz and Bor, this volume, Lupova-Henry and Dotti, this volume). Owing to their increasingly hybrid membership, some clusters can further be conceived as multi-stakeholder meta-organizations (Berkowitz, 2018), that relate to and involve, more or less closely, third sector organizations, the social or solidarity economy (SSE) (Lemaître & Helmsing, 2012; Petrella et al., 2021; Saniossian et al., 2022). Member-organizations composing such clusters present a diversity of institutional statuses,. This

diversity can be understood in relation to the cluster's role of coordinating new activities, sectors and functionalities in the territory. For Rullani (2011), a theorist of industrial networks transformations, this consists of creating or reinforcing spaces with new physical, legal and moral constraints (e.g. third places).

Clusters' quest for legitimacy in transition studies and STI literature, and the assessment of clusters' relatively weak contribution to sustainability transitions so far call for new steering practices. Re-designing old clusters or designing new ones as transformative agents requires rationalizations both at their governance level (the meta-organization) and at the level of member-organizations and employees' work (sectors involved). Clusters can be organized as actors rather than simply result from environmental or institutional pressures that shape a geographical zone (Lupova-Henry et al., 2021). This involves drawing on organizational components, like membership, hierarchy, rules, monitoring and sanctions (i.e. structural organizationality), actorhood or collective identity (i.e. entitative organizationality)(Grothe-Hammer et al., 2022). Clusters as meta-organizations may present more or less structural organizationality (Berkowitz and Bor, this volume), and similarly can achieve or not entitative organizationality.

Organizing and recognizing players in a cluster as a formal meta-organization is however not sufficient per se to ensure transformative change. The development of labor adapted to the implementation of transition processes is necessary. Taking into account work and employees in clusters is essential as systemic sustainability transition involves profound transformations of vocational education and training, upskilling or reskilling of the workforce (Hazelkorn & Edwards, 2019). How to address these issues in the design of clusters is the object of the next section.

META-ORGANIZING CLUSTERS FOR TRANSITION

We make the key assumption that clusters can be designed as transformative meta-organizations if they gain responsible actorhood for the transition. Hereafter, we develop the notion of responsible actorhood as a combination of three properties, i.e multi-directional, meta-organizational accountability for decisions, transformative mediated reflexivity about socio-environmental effects and negotiated professional restructuring as synthesized in table 1.

Table 1 : Achieving responsible actorhood.

Concept	Definition	Main outcome
Responsible actorhood	A system of autonomous decision making externally recognized as an actor, and which decisions highlight a care for future generations and a commitment to enacting a sustainable future	Enabling clusters and meta-organizations in general to have transformative outcomes
Multi-directional, meta-organizational accountability	Complex ties of accountability between the meta-organization and its members, and between the meta-organization, members and external publics	Addressing the answerability issue
Transformative mediated reflexivity	A continuous process mediated by the meta-organization and consisting in identifying, reflecting upon and integrating external changes as well as impacts on all publics (including nonhuman publics)	Mitigating the path dependency towards growth
Negotiated professional restructuring	A deliberative process enabling cluster's stakeholders to renew and adapt their professional and labor activities to technological or social ruptures, especially as a result of meta-organizational accountability and transformative mediated reflexivity	Transforming risks of labor resistance into labor adaptation to the new professions and sectors of the transition

Responsible actorhood

A paradoxical tension in meta-organizations exists between dependence over member-organizations to exist, and a form of autonomy that is necessary to gain organizational actorhood: "meta-organizations are autonomous actors with autonomous actors as

members" (Ahrne et al., 2019, p. 392). We follow the classical view of actorhood as an external recognition, i.e. the organizational attribute that an organization gains when it becomes externally perceived as an addressable actor (Dobusch & Schoeneborn, 2015; Grothe-Hammer et al., 2022; King et al., 2010). Here, actorhood therefore differs from agency, in the sense that organizations can have agency, i.e. take actions and have an organizing effect, without necessarily achieving actorhood (Berkowitz et al., 2020). Like Lupova-Henry et al (2021), we assume that actorhood can be constructed. We conceive it as a form of organizationality at the level of the entity, or entitative organizationality (Grothe-Hammer et al., 2022).

Actorhood thus implies a the existence of an autonomous system of decision at the level of the meta-organization itself, as well as the external attribution of responsibility for these decisions (Dobusch & Schoeneborn, 2015; Grothe-Hammer, 2019). 'Responsible' here refers to "a collective commitment of care for the future" (Owen et al., 2013, p. 36), that is to say taking action that ensures the realization of socially desirable outcomes (Berkowitz, 2018). It then follows that *responsible* actorhood does not mean solely taking responsibility for decisions but rather means taking decisions that enact a sustainable future.

Achieving responsible actorhood at the meta-organizational level while maintaining members' autonomy allows to empower territories to develop sustainable and responsible innovations through experimentations. Meta-organizational responsible actorhood of clusters is thus embedded in regions, territories and place-making (Berkowitz et al., 2020). The emergence of territorial or place identity in transition studies (Binz et al., 2020) is coupled with a growing importance of self-organizing (Berkowitz et al., 2020). In that context, there can be a tension between territories as vehicles for innovation policy, and territories as places that have their own resources, identity, and trajectories of regional

development (François et al., 2013). Meta-organizing clusters as agents of transformative change, through responsible actorhood, can make them valuable intermediaries (Kivimaa et al., 2019) that develop place-based collective reflection and strategy about the transition.

Hereafter we argue that responsible actorhood results from a combination of three meta-organizational properties that aim to solve three issues. The first issue is the lack of answerability for decisions, which is solved by developing mechanisms of multi-directional meta-organizational accountability. The second issue is path dependency towards growth, which we argue can be mitigated through transformative mediated reflexivity. And lastly, the issue of adaptation or resistance to change by labor forces, which can be tackled through negotiated professional restructuring.

Multi-directional, meta-organizational accountability

One main issue of meta-organizations in general, and clusters in particular, when it comes to sustainability transition, is the lack of answerability for socio-environmental impacts. Contrary to businesses, and in particular publicly listed ones, meta-organizations have generally no obligation to report on their sustainability progresses. Owing to their opacity and discursive strategies, meta-organizations can escape responsibility attribution or strategically shift responsibility to specific actors (Carmagnac et al. 2022). We understand relatively little about their positive or negative contributions to sustainability (Berkowitz & Bor, 2018; Carmagnac et al., 2022). Against this backdrop, gaining responsible actorhood means that meta-organizations must become accountable for their decisions as an autonomous actor, and further for their socio-environmental impacts.

Accountability has a double meaning. By being (held) accountable, an organization is both taking responsibility for its decisions and actions but also being held responsible by external agents (Cornwall et al., 2000). Owing to this double dynamics and the

dependence-autonomy tension, it follows that accountability dynamics in meta-organizations are quite specific and complex (Ahrne et al., 2019). Member organizations do not merge into meta-organizations but they retain their own actorhood, identity and decision-making processes (Ahrne & Brunsson, 2008). Meta-organizations therefore constitute organizations where social orders and decision-making processes are layered (Grothe-Hammer et al., 2021). This has implications for accountability: it can make it difficult to set accountability mechanisms as member organizations can deny responsibility, but also simply to understand who is accountable to whom and how (Berkowitz & Bor, 2018). This is particularly the case in the absence of actorhood.

The nature of meta-organizations can explain their specific accountability. Meta-organizations are voluntary associations of members that are themselves organizations (Ahrne & Brunsson, 2008). Owing to their high dependence on their members to whom they provide services (Berkowitz & Bor, 2018), meta-organizations may naturally imply some form of accountability systems. But accountability is also necessarily multidirectional in meta-organizations (ibid). Member-organizations are made accountable to the meta-organization, and the meta-organization is made accountable to its members. Both member-organizations and the meta-organization are also made accountable to a variety of external agents: those nonmembers who provide resources for instance (states, the EU, etc) (Bor, 2014).

But in meta-organizations tackling grand challenges or contributing to sustainability transition, accountability also involves a broader range of stakeholders like society as a whole and even nature (Laine, 2010; Starik, 1995). Dewey (2012) argued for the integration of all publics, who are not only human but also entities such as soils, atmosphere, rivers, forests and their biological diversity. Being held accountable to these publics is needed to take responsibility for the problems arising from the direct and

indirect consequences of social action in complex societies. In that perspective, responsible actorhood means to jointly develop and agree upon specific rules of transparency, mechanisms and tools of accountability towards these various stakeholders or publics (Mirvis & Worley, 2013). Multi-stakeholder meta-organizations, that internalize various publics, may develop specific accountability criteria, including transparency of information, inclusion of affected stakeholders, procedural fairness and efficacy (Hennchen & Schrempf-Stirling, 2020).

The case of Suwa industrial region in Japan illustrates the challenges of meta-organizational accountability of an industrial cluster initially specialized in machinery and metal industry (Sato & Okamoto, 2017). This specialization led to the reuse of advanced technologies in eco-friendly products, renewable energy and services for life quality (care for elderly people). The meta-organization, SUWAMO, was created by stakeholders such as chambers of commerce and industry, employer associations, and municipalities (which deal also with care services for elderly people at home). The objective was to form a cross-regional and cross-departmental agency whose stakeholders were extended to representatives of central government services, support agencies, and universities (including outside the region). SUWAMO's multidirectional form of accountability is the result of a transformation of local networks through the actions of the Region, the State and local firms.

When they achieve meta-organizational responsible actorhood, member-organizations can no longer hide behind the collective for jointly made decisions. They become jointly answerable, through the meta-organization and thanks to multidirectional accountability mechanisms. This idea of a complex configuration of multidirectional, meta-organizational accountability echoes to the multilevel perspective of innovation that some research in the field of sustainable regions and transition suggest (Gibbs, 2018). Meta-

organizational accountability for clusters transitions requires a place based approach in a multilevel perspective. It is the interplay of actors, places, identities, resources and political alliances committed to sustainability transitions that gives it meaning and direction, and therefore builds the basic ties of accountability.

Transformative mediated reflexivity

Drawing on Dryzek and Pickering (2018) analysis of institutions, we can argue that clusters follow what they call a pathological path dependency towards economic growth, due to their use as competitiveness policy instruments. Ecological reflexivity, according to Dryzek and Pickering (2018), can help adapt to grand challenges. Reflexivity is needed to 1) identify and acknowledge changes in socio-ecological systems, 2) reflect on these changes and how institutions may adapt to them, and 3) reconfigure norms, discourses and instruments in consequence.

Therefore, we can argue that mediated reflexivity (Gadille, 2008; Gadille et al., 2013a; Xhauflair, 2013), i.e. the active and continual accounting for and discussion of one's own performativity, is crucial for clusters' transition. This mediated reflexivity needs more specifically to address technological ruptures and the cluster's ecological performance. Literature has shown that governance of clusters involves mediation to move beyond contradictions existing among stakeholders (Dotti & Lupova-Henry, 2020).

Taking inspiration from the above-mentioned works, what we call 'transformative mediated reflexivity' ensures that clusters' actions do not remain limited to energy or resource efficiency but actually trigger deep, transformative change. This reflexivity is mediated because it happens at the level of the meta-organization. In a context of 'polycentric city-regions' (Soja, 2015), it may require going beyond the sectoral boundaries of the cluster. The objective is to favor sustainable innovations by encouraging experimentations (Rogge et al., 2020) and by developing new combinations

of activity involving ‘related and unrelated variety’ at cross-sectoral and inter-cluster levels (Boschma et al., 2017; Frenken et al., 2007). A cluster can redefine its boundaries in order to survive, and change its relatedness both with stakeholders and public policies. Reflexivity mediated by the meta-organization can also result from an external intervention on behalf of the collective. For instance, Gadille et al. (2013b) show that the intervention of social scientists revealed the key role of medium tech subcontractors in the aeronautics and space cluster. They thus highlighted the importance of creative competences. Said researchers were commissioned by the secretariat of the meta-organization. During their prospective work on the evolution of jobs and skills in this cluster, they observed the relationship between purchasers and the small and medium size suppliers in the cluster. The latter felt that their added value, and even their intellectual property, was discredited by the main purchasers. Local suppliers were indeed placed in head-on competition with suppliers in low costs countries, who did not yet propose any innovation in the sub-systems supplied for an aircraft. This reflexivity was crucial in understanding the necessary changes in the cluster to foster more sustainable development.

Lupova-Henry et al. (2021) also show that the secretariat, usually studied as an executor of the board of directors and the advisory committee’s decisions, can play a tacit role in the production of new knowledge feeding the reflexivity of the member-organizations. It can call upon a third external actor (e.g. an academic consultant) to carry out a diagnosis of the practices and strategies of the cluster members, in relation to other sectors of the regional territory. In so doing, the secretariat made it possible to shift the boundaries of the cluster to extend it beyond the mining sector. It has therefore taken on the task of helping members understand that they can move into other areas such as medical equipment, food, and a whole range of other activities. In this case, reflexivity helps raise

awareness that membership of an industry association does not necessarily mean being restricted to that industry. Reflexivity may therefore come not only from the shared knowledge production by the meta-organization and third parties. It can also result from the capacity of this knowledge to reveal the functioning of a social order in which the actors act 'naturally' without being aware of it. By revealing its functioning, the meta-organization can thus extend or move the social order's boundaries.

Reflexivity and accountability are connected. Transformative mediated reflexivity can always call into question the autonomy of the meta-organization, as a condition to be recognized and accountable in terms of actorhood. From this perspective, the transformative mediated reflexivity of a cluster deals with multidirectional translation activities between stakeholders, public policy makers and public problems. Thus, these publics can also be taken into account and integrated in meta-organizational processes of reflexivity.

Social and Solidarity organizations as stakeholders of a cluster, face the same limits as for profit organizations do in their capacity to steer transformative change in favor of ecological performances. Sahakian (2016) argues that the concept of the social and solidarity economy fully embraces the 'Social equity' dimension of ecological performance transformation. However, this concept is people centric but not public centric according to Dewey's definition. We can call it people centric rather than simply anthropocentric because it aims to place service to communities above profit. It also embraces the notion of reciprocity through social entrepreneurship, crowdfunding, fair trade, community currencies and some forms of peer-to-peer sharing. This conception is important for the transformative mediated reflexivity of meta-organisations, but it is not sufficient. We suggest that the capacity to take all publics into account through the meta-organization depends rather on its capacity to intermediate interactions between for-profit

and not-for-profit organizations involved in collective experiments and initiatives, and non-human publics (i.e. ecosystemic impacts).

Ultimately, reflexivity at the cluster or meta-organization level is transformative when it contributes to the construction of a 'grammar' of territory and territoriality defined by the aim 'to affect, influence or control people, phenomena and relationships by delimiting and asserting control over a geographic area' (Sack, 1986, p. 19; cited by Paasi et al., 2018). Mediated reflexivity becomes transformative precisely when it produces social order changes for more sustainability. As such, designing clusters for sustainability necessarily acknowledges the spatial and geophysical dimensions of clusters and of system transition. Reflexivity thus means taking into account the identity of the cluster's place or territory, its specific resources and context (Binz et al., 2020; François et al., 2013). However, being reflexive also raises issues of labor adaptation to these necessary changes.

Negotiated professional restructuring

Another issue is the adaptation of professions in the cluster, or more generally the MO's members, to the transition. Professions and organizations of the regime system may resist transformations towards sustainability (Geels, 2014). We therefore lastly suggest that 'negotiated professional restructuring' is crucial to organize clusters as transformative agents. Negotiated professional restructuring consists in a deliberative process enabling cluster's stakeholders to renew and adapt their professional and labor activities to technological or social ruptures, especially as a result of meta-organizational accountability and transformative mediated reflexivity. Further drawing on Dewey (2012), if meta-organizational responsible actorhood means accounting for all impacts on all publics, including the biosphere, then it follows that meta-organizations must be able

to transform their activities, knowledge processes and empowerment mechanisms to take on that responsibility.

Professionality refers to individuals' purposes and capacities to acquire and actualize new knowledge and skills. Production processes adopted at the company level leave few margins of autonomy for sustainable professionality (Marasco, 2018). Thus, transitioning clusters transforms professionalities based on a process of place-making or 'territorialization', i.e. anchoring them in territories. Employees and member-organizations must develop new skills to address the challenge of sustainable innovation and transition. But they also need to use international networks, which contribute to knowledge exchanges, and at the same time re-organize production locally. A meta-organization becomes an agent of transformative change when it succeeds to act as this intermediary. And when it balances the constant back-and-forth between the expectations and competences of its stakeholders with the collective commitment to take responsibility for the future towards the publics.

De Rosa and Trabalzi (2017)'s study of the failure of an agricultural meta-organization can be illustrative of this. They highlight the lack of back-and-forth enabling professional restructuring. The Campagna Amica Foundation was created in Roma to sustain the rurban territorial system. It sought to build a meeting place for farmers and citizens in the three main areas of direct sales, tourism and eco-sustainability. Its members are mainly farming cooperatives. It has been promoted by Coldiretti, the main farmers' trade union in Italy, and extended through all the Italian regions with local networks of market places where citizens can access local products. De Rosa and Trabalzi (2017) show that the meta-organization failed to adapt to and draw on a local actor's needs, the School Meal program. This program has been promoted by the municipality of Rome, teachers, families, dieticians since the mid-2000. It aims at supplying organic and local, quality

food to public schools in Rome. But the local productive system failed to provide for it. The program had to procure food from further away. One main explanation for this failure was the exclusion of stakeholders in the coordination of the meta-organization to foster its development. The transformation of its members' knowledge towards civil society's expectations, i.e. here organic farming for local schools, might have had a better chance of success if embedded in a professional restructuring at the local system level. But the link between the meta-organization and the national farm union deterred the development of new relationships with others local actors. It thus prevented them from building multi-directional accountability, transformative reflexivity and lastly professional restructuring. The changing professionality operates at two levels: that of cluster members and that of employees hired by the meta-organization to pool resources. As members of clusters, universities necessarily play a key role in this. However, this restructuring can be piloted by the meta-organization itself to better coordinate these various transformations in training, upskilling and reskilling. While this restructuring necessarily operates at a very local level, it also needs to involve national and transnational frameworks and agents. This is especially relevant to integrate policies that have impacts on vocational education strategies (RIS3 smart specialization, European green deal, etc) (see for instance Hazelkorn & Edwards, 2019). Ultimately, only in this always multi-scalar meta-organizational re-composition of objectives, accountability and socialization processes, can clusters play a transformative role in sustainability transition.

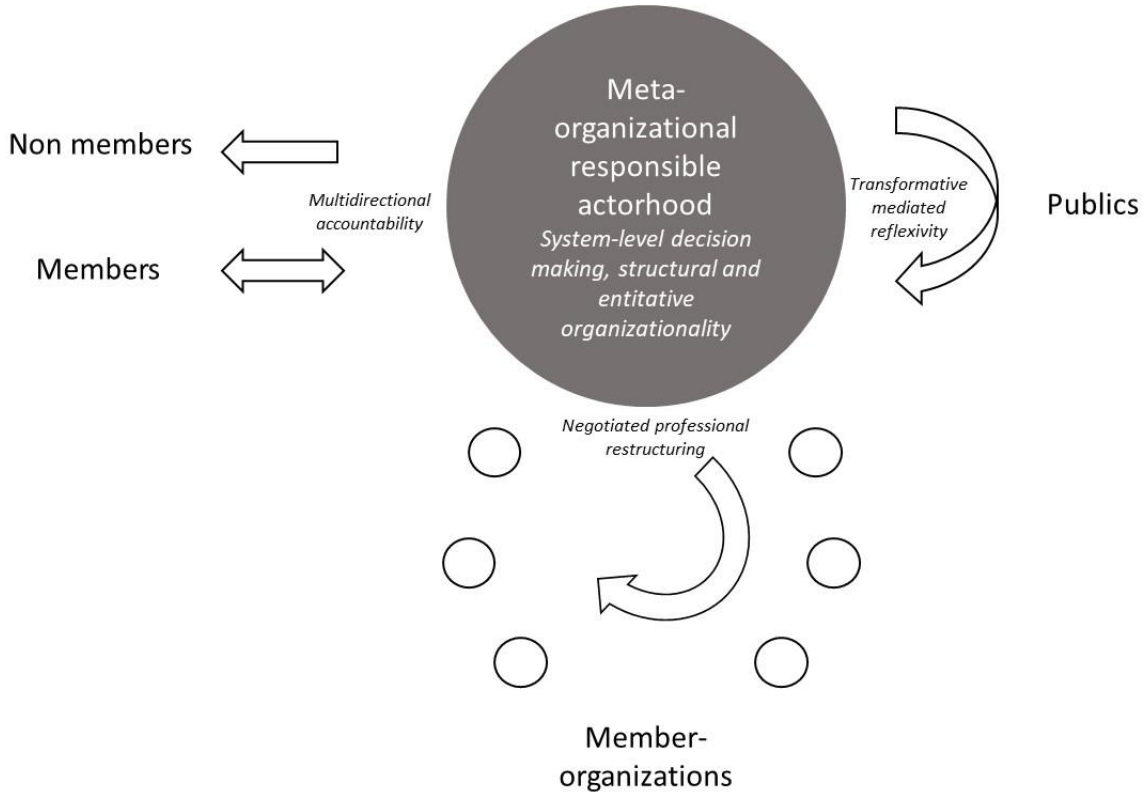
DISCUSSION AND CONCLUSION

How to organize clusters as local agents of transformative change, i.e. players that actively contribute to systemic sustainability transitions anchored in territories? Recent literature on Transition Studies, and more specifically on Science and Technology

Innovation (STI) Policy, argues that a new frame of STI policy is needed, one that focuses on transformative change, experimentations and deliberative governance (Köhler et al., 2019; Schot & Steinmueller, 2018). In what they call the third frame of STI, clusters tend to be somewhat overlooked, as an outdated policy instrument of the 80s. Yet, their geographical omnipresence in Europe and in the rest of the world makes them important tools that need to be not only integrated in transition strategies but also strengthened or redesigned for this very purpose. We investigate under which conditions clusters can provoke system level transformative change for sustainability transition.

Bridging industrial ecology literature and Science and Technology Innovation policy, we take a meta-organizational lens on the design of clusters for sustainability. Furthering Lupova-Henry et al (2021), we make the key assumption that gaining 'responsible actorhood' is a crucial organizational condition for clusters to act as local agents of transformative change. Only under this condition can clusters be meta-organized to solve several obstacles to transformative change, i.e. lack of answerability, path dependency to growth and lack of labor adaptation to sustainability. Responsible actorhood means that the meta-organization presents a system of autonomous decision making and is externally recognized as an actor ("entitative organizationality", (Grothe-Hammer et al., 2022)). It further means that this autonomous, addressable actor is committed to a sustainable future (Berkowitz, 2018). We develop 'responsible actorhood' around three main properties which are needed to meta-organize clusters for transition purposes, that is to say to (re)design the industrial system at the meta-organizational level for sustainability. We synthesize these properties in figure 1.

Figure 1: A model of meta-organizational responsible actorhood



We first argue that responsible actorhood of a meta-organization involves developing mechanisms to ensure multi-directional, meta-organizational accountability, in order to ensure answerability. This means that meta-organizations are (held) accountable for their actions, and that this accountability concerns several publics, in the sense of Dewey, from civil society to nonhuman publics like the biosphere. This further translates in nurturing 'transformative mediated reflexivity' at the meta-organizational level about technological ruptures and ecological performance. Transformative mediated reflexivity means solving the issue of path dependency to growth by taking a public centric approach of impacts, i.e. whether on people or the biosphere. Lastly, multi-directional meta-organizational accountability and transformative mediated reflexivity require enabling 'negotiated professional restructuring' to establish new knowledge processes at work and thus tackle the risk of labor resistance to sustainability.

This work contributes to several literatures. First, it contributes to STI/transition studies and cluster literature (Baldassarre et al., 2019; Schot & Steinmueller, 2018) by bridging

the two approaches and unpacking the organizational conditions under which clusters can be designed as transformative agents for the transition. We do so by emphasizing the importance of places making in transition of clusters and how they can become intermediaries for the transition (Binz et al., 2020; Kivimaa et al., 2019). We further contribute to this extensive literature by highlighting the value of clusters as meta-organizations that can foster local experimentation and deliberative governance for the transition of territories.

We also contribute to the growing meta-organization literature (Ahrne & Brunsson, 2008; Berkowitz & Bor, 2018; Spillman, 2018) by analysing the territorial anchorage of meta-organizations such as clusters (Lupova-Henry et al., 2021). Most works in the meta-organization literature have focused on cases disconnected from the territory or space, mostly operating at the national (Berkowitz & Souchaud, 2019; Spillman, 2018) or international level (Ahrne et al., 2019; Carmagnac & Carbone, 2019). We in particular add to the recent critical discussion about meta-organizations' roles in sustainability, their potential dark side and how to prevent counter-productive strategies (Carmagnac et al., 2022).

We suggest that the redesign of established industrial players for sustainability transitions might be understood using a meta-organizational approach and more generally an evolutionary, regional pluridisciplinary approach of local systems dynamics. This means highlighting the very immaterial aspects of 'territorial capital' (cognitive, social, relational and identity capital) inherited from slow historical processes that are not necessarily oriented toward economic goals (Camagni et al., 2009). As such, we go beyond the Neo-Marshallian view focused on interpreting small firms systems rather than innovation processes.

Our findings are transferable to other settings, especially to other emerging countries. In the context of re-territorialized globalization, our findings need to be attuned to the differentiated policy and urban trajectories forged by geo-historical relations of power (colonialism, imperialism, global capitalism) in order to foster inclusive alternatives and directionalities of sustainability transition (Kanai & Schindler, 2018; Pansera & Owen, 2018). Our work also has policy and practical implications for the design and steering of eco-industrial clusters, in particular in other settings than clusters based in developed countries.

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