

Review

Importance of Actors and Agency in Sustainability Transitions: A Systematic Exploration of the Literature

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Abstract: This article explores the role of actors and agency in the literature on sustainability transitions. We reviewed 386 journal articles on transition management and sustainability transitions listed in *Scopus* from 1995 to 2014. We investigate the thesis that actors have been neglected in this literature in favor of more abstract system concepts. Results show that this thesis cannot be confirmed on a general level. Rather, we find a variety of different approaches, depending on the systemic level, for clustering actors and agency as niche, regime, and landscape actors; the societal realm; different levels of governance; and intermediaries. We also differentiate between supporting and opposing actors. We find that actor roles in transitions are erratic, since their roles can change over the course of time, and that actors can belong to different categories. We conclude by providing recommendations for a comprehensive typology of actors in sustainability transitions.

Keywords: transitions; actor typology; agency; sustainability

1. Introduction

The scholarly literature on sustainability transitions has been evolving rapidly. Although originating in evolutionary economics and complex systems approaches, parts of this literature stress the importance of agency for successful transitions [1–5]. Dominant concepts in transitions research, however, such as the Multi-Level Perspective (MLP), have been criticized for insufficiently considering agency [6–8]. Such criticism has been countered by arguing that the MLP is “shot through with agency, because the trajectories and multi-level alignments are always enacted by social groups” [9] (p. 474). On the whole, both actors and agency have been subjected to very different treatment in the transition literature regarding their alleged significance [10,11]. The work of Giddens, for example, has been perceived as both very positive and very negative for privileging agency [10].

Important considerations for a comprehensive perspective on actors in transitions have been provided by Avelino *et al.* [12], who develop a multi-actor perspective to understand transition politics especially in conceptualizing shifting power relations. Another more general perspective is provided by Farla *et al.* [1], who consider actors in conjunction with resources and strategies in transitions. We find a strong thematic research focus on energy issues [13–15] and a geographical focus in the Netherlands [16–19] and partly in the UK [20–22]. Also represented in the literature is research about actor-based modeling, for example, of energy infrastructure projects [23] or, more generally, on modeling socio-technical transitions patterns and pathways [11]. There is a substantial body of literature that does not have actors or agency as a primary focus in their work. The topic of actors and agency is often times more or less implicitly covered, since it is clearly included and integrated in most of the other themes and topics in research.

In this article, we explore the role of actors and agency in transition studies—both in terms of concepts used, and in terms of associated typologies. We study whether or not agency is (quantitatively) falling behind more systems oriented concepts in the transition literature, and what actor-related concepts are most prevalent in this literature.

To this end, we perform a systematic exploration of 386 relevant journal articles (Supplementary material 1) listed in Scopus for their treatment of agency and actors. We examine the different types and concepts of actors relevant to transition research, specifically focusing on their functions for sustainability transitions. We begin by introducing the principal concepts (Section 2), followed by a description of our research method (Section 3), and then present the results of a quantitative analysis of all 386 articles on frequencies of key actor- and non-actor-related terms in transition thinking (Section 4). To gain insights about the current use of actors and agency in transition literature, we present results of a qualitative analysis of a sub-set of articles (Section 5). We conclude by outlining further directions for an integrated actor typology in sustainability transitions.

2. Concepts

Following Bos *et al.*, we refer to individual and collective actors as participants in purposive actions in an attempt to prevent or generate change [24]. Agency, then, relates to actor behavior with regard to such change [25]. Agency implicitly underlines the “undetermined nature of human action, as opposed to the alleged determinism of structural theories” [26]. An overall definition and structure of actors in transition literature is still missing, which is also confirmed by Avelino and Wittmayer, who discuss a conceptual ambiguity in the literature. This means a certain lack of clarity about actors being individuals or individual organizations, more generalized categories of actors or roles of actors [12]. Avelino and Wittmayer point out that there is a research gap for a systematic understanding of actors in transition processes, and develop a multi-actor perspective as “a heuristic framework for specifying different categories of actors at different levels of aggregation” [12] (p. 17).

As mentioned above, there is a dichotomy between agency and system. Following Giddens [27], structuralism and functionalism both emphasize the society in its entirety more than its individual parts (e.g., actors). This dichotomy is also displayed by other sociological theories that are characterized by their emphasis on either agency or structure. One of the core concepts in sustainability transitions, the Multi-Level-Perspective, has been criticized for insufficiently considering agency. Specifically, it has been criticized for focusing on technology and for having a “narrow focus on the socio-political aspects of transition” [28] (p. 1091). In a similar vein, Genus and Coles suggest that further research is necessary, and to “consider the contribution and interaction of diverse groups to socio-technical transformation or stability”, as well as an analysis of protagonists and affected parties behavior and assumptions in technology development, “in relation to regimes and niches” [7] (p. 21). Contrarily, researchers argue that the MLP is “shot through with agency because the trajectories and multi-level alignments are always enacted by social groups” [9] (p. 474). In his early work, Geels explains socio-technical systems as outcomes of the activities of human actors [29]. He distinguishes between human actors and social groups, where “human actors are embedded in social groups which share certain characteristics (e.g., certain roles, responsibilities, norms, perceptions)” (p. 902). Furthermore, Geels’ work conceptualizes dynamic interactions between actors, rules and socio-technical systems, where, the “perceptions and activities (of human actors) are coordinated (but not determined) by institutions and rules” [29] (p. 902). However, it is not only the MLP that has been criticized. Rauschmayer *et al.* [8] attempt to identify elements missing in TM and conclude by stating that TM is not looking at individual agency as a potential driver of transitions. The authors suggest a heuristic combination that puts individuals back into the study of sustainability transitions. On the contrary, other authors have observed that actors engage at several levels in transitions, and are not working in isolation [30,31].

Motivated by the actor-system debate in transitions, our work contributes by identifying and discussing typologies of actors with regard to their role in transitions, and through a quantitative

analysis, which examines possible trends in the treatment of actors *versus* systems concepts in the literature.

To structure our analysis, we identify three different typologies.

- (1) The Multi-level Perspective on transitions (MLP) is considered to be a key contribution and core research strand in the field of transition studies [5]. It is a framework that distinguishes between three analytical levels with increasing temporal stability: niche (flexible and fluid), regime (semi-stable) and landscape (slow societal processes that provide the context for regime stability or change). Transitions, defined as regime change, are explained by an interplay between niche innovation, internal regime change (or resistance) and landscape factors. We should note that these levels themselves do not have agency. However, actors and their actions can often be associated with particular levels (e.g., niche), which is why parts of the literature have begun to explicitly relate actors to the MLP-levels, referring specifically to niche and regime actors [9,32,33]. This is an important shift in focus for analyzing transitions.
- (2) Taking the perspective of governing transitions towards sustainability introduces two further actor typologies. Governance is understood as public decision-making beyond, but also including, the state. Actors who participate in governance are commonly divided into state (government), private sector (business) and civil society actors (e.g., Grin [4] and Loorbach [25]).
- (3) The governance perspective also assigns actors to the respective spatial levels of decision-making. The field of multi-level governance—not to be confused with the Multi-Level Perspective on transitions—studies the multiple interactions between governance on local/municipal, regional/state, national and international levels [34].

In addition to these three typologies, we added intermediaries as a fourth category. Intermediary actors are explicitly mentioned in the transition management literature as being crucially important in multi-actor transition processes [25]. Since none of the other typologies includes intermediaries specifically, and the literature suggests that they play an important role in transitions, we elaborate on them in an additional section.

3. Method

The basis for this investigation was an intensive literature search using the bibliographic database *Scopus*. We used the initial search string “*transition management**” OR “*sustainab* transition**” OR “*socio-technical transition**”. “Transition management” (TM) was chosen as a search term because it combines the three key issues we consider essential: transition, sustainability, and governance. First of all, TM “uses the concept of sustainable development as a normative frame to develop the future orientation (vision)” [25] (p. 25). TM can also be seen as a form of metagovernance for affecting and managing actors and networks [25]. Governance, defined as interactions between choices made by different actors within the system, is central to transitions.

With regard to the other two search terms, sustainability transitions can be defined as “long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption” [5] (p. 956), whereas “a socio-technical transition is a set of processes that lead to a fundamental shift in socio-technical systems” [5] (p. 956). Using the latter two general search terms, we obtained information about more specific concepts mentioned in a transitions context, such as the MLP and Strategic Niche Management (SNM), with which we were able to contrast TM.

Our initial search was restricted to literature published up to September 2014 (date of search: 28 September 2014), yielding 740 scholarly articles. In a second step, we excluded conference papers and articles in foreign languages. Then, our sample was manually refined, guided by the following two criteria:

- (1) Does the paper contribute to the research field of transition or transition management in the context of governance?

- (2) Does the paper contribute to understanding the governance of sustainability transitions more generally? For example, we have included articles dealing with other concepts such as Adaptive Management [35] or Strategic Niche Management [36] since this seemed to be an interesting lead to follow up on in our selected literature.

Our refinement produced a total of 386 scholarly articles, which we analyzed quantitatively and qualitatively. In our quantitative study, we searched and counted occurrences of 118 key terms involving actors and agency and describing systems-oriented key concepts. These terms emerged, based on our expert knowledge, from reading, analyzing and discussing selected articles [6,37–44], which we consider to be of great interest in the field of sustainability transitions. Key terms were grouped into different clusters based on whether the context involved (a) a systemic approach; (b) an actor-centered approach; or (c) a mixed/neutral context. Due to the low numbers of mentioned terms, we excluded the years 1995–1996, and to achieve sufficiently high counts, we clustered the years 1997–2001 and 2002–2006 (Figure 1). A methodological weakness of this quantitative approach is that just because specific terms are not used in the studied texts, this does not necessarily imply that the underlying concepts have not been used, rather authors could have chosen different terms. Whereas the quantitative analysis included articles through September 2014, our qualitative study primarily used selected articles through 2012, and additional relevant literature to obtain a deeper understanding of how actors and agency are used in transition literature. Our qualitative analysis focuses on the functions of actors, their dependencies and their roles in transitions.

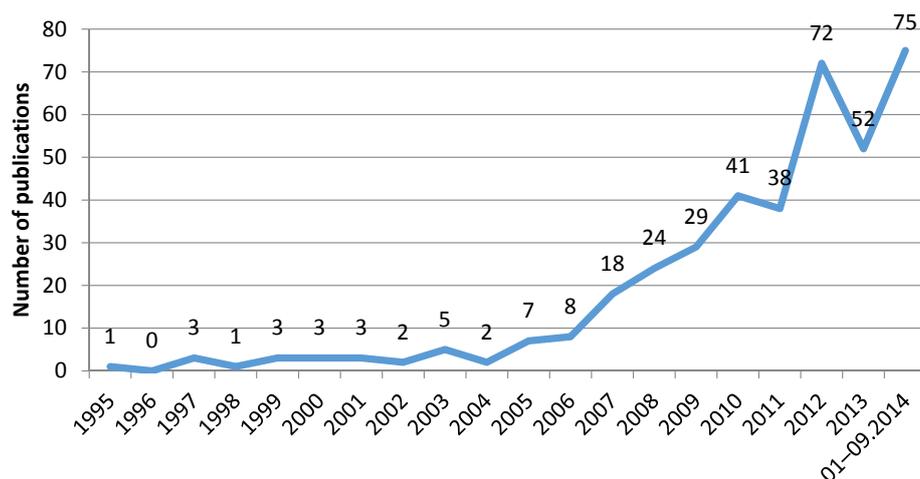


Figure 1. Number of annual publications in the selected literature on transitions (1995–2014). Data collected on 28 September 2014.

4. Quantitative Survey of Actors in Transitions

Our findings clearly show a continuous increase of publications in the field of sustainability transitions, indicating a rapidly growing interest in this field. The number of publications per year remained at a consistently low level until about 2005, followed by a significant takeoff beginning in 2006 and peaking at 72 publications in 2012. After a short drop in 2013, publications again peak at 75 articles in 2014 (through the data collection date of 28 September), and are expected to continue to increase (Figure 1).

We examined the quantitative development of both actor-related and systems-related terms and calculated the top 10 terms for each cluster (Appendix A). Of course, this approach does not allow for an absolute comparison of the two clusters. However, it does allow for comparison of the temporal development. As Figure 2 shows, both sets of terminology have been present in the transition literature with no discernible trend. This refutes the hypothesis that actor-related concepts are now being more strongly included in the transitions literature than in earlier years.

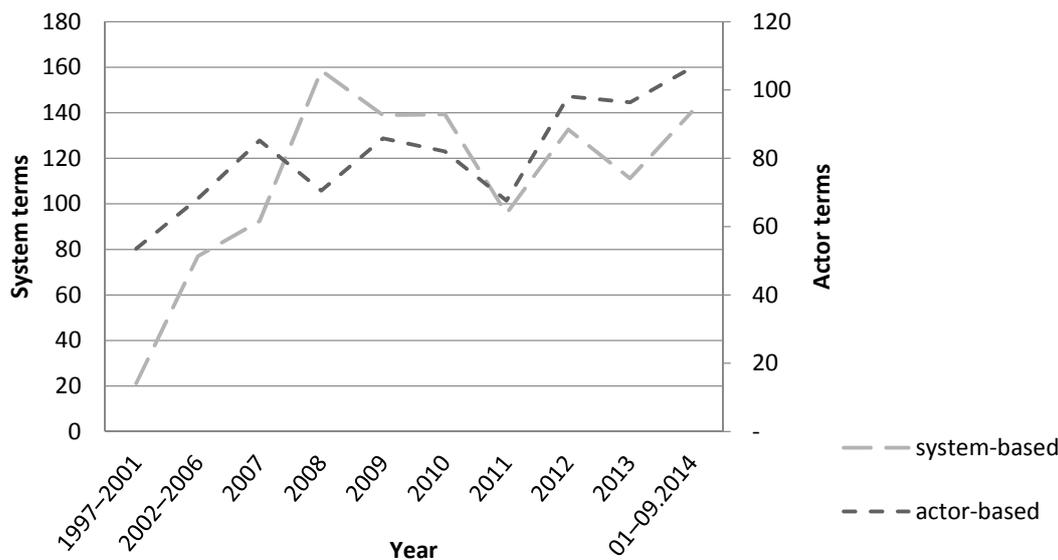


Figure 2. Development of occurrences of the top 10 actor- and system-based terms (average uses per article).

We compare the average use of terms between 1997 and 2014 in a bar chart (Appendix B) illustrating the 40 terms with the highest ranking. The top 10 ranking were the following terms: “system/s”, “regime/s”, “actor/s”, “niche/s”, “international/global”, “network/s”, “local”, “government/s”, “firm” (comprises the terms firm/s, company/ies, and corporation/s), and “path” (comprises the terms path/s and pathway/s).

We additionally evaluated the time trend of each of the 118 search terms (Supplementary material 2). We found no significant trend except for a clearly positive trend for the term “network/s”. Since our data included literature up to September 2014, we assumed that the numbers for 2014 would further rise in a steady trend. One possible reason for this might arise from TM and its network approach.

5. Outlining Different Actor Categories in Transitions

It seems reasonable to assume that actors and agency are intensely discussed topics in the transition debate both because there is a diverse range of actors involved and because actors’ behavior is complex [5,45,46] and depends on the “values they hold, the resources they command and the strategies they choose to follow” [45] (p. 6). Moreover, these values, resources and strategies “are in turn influenced by the institutional factors of national policies, market rules and regulatory structures” [45] (p. 10). This heterogeneity might seem problematic in terms of collaborating toward a transition. However, the literature is clear about the necessity of heterogeneities, since a multi-actor process can prevent lock-ins and increases resource availability [1,9,47].

Our paper focuses on providing a general overview of how actors and agency are used in transitions by mapping relevant actor typologies across all literature. It is important to note that we are not trying to present definite accounts of what is happening in transitions. Rather, we prefer to present functions and dependencies of actors in transitions. On these accounts, we are then looking at different degrees of influence actors can have in a transition.

5.1. Actors in the Multi-Level Perspective

The Multi-Level Perspective on transitions (MLP) is one of the most commonly referred to frameworks for distinguishing between different realms of importance for transitions. Several authors refer to the MLP to distinguish among actors associated with niche, regime or landscape, respectively, and thus distinguish their role for (sustainability) transitions.

5.1.1. Niche actors

Niches can either be supporting or opposing forces in transitions [48]. Based on the observed literature, we find that at the niche level, new radical social and technological ideas emerge. Niche actors aim to distribute these ideas to have them adapted by the incumbent regime or even replace existing ideology. According to Geels (2012), niche actors can therefore create a starting point for a systemic change, although this is difficult because lock-in mechanisms can stabilize the incumbent regime [9]. At this micro-level, actors can be “individuals or small groups of actors, with local practices which differ from the regime” [11].

According to Jorgensen, niches do not restrict actors the way that the regime and landscape levels do because they are less stabilized and defined [30], and their protective space supports more agency for experimentation [49]. Foxon (2010) finds that niche actors work on radical innovations and are involved in several processes, such as knowledge development and diffusion, articulation of visions, entrepreneurial activities, market formation, guidance of search activities, mobilization of resources, creation of legitimacy and the overcoming of resistance to change [45]. A number of authors argue that a criterion for a successful niche emergence depends on changes in government policy and support [9,50]. Arguably, this underlines niche actors’ dependency on decisions made by policymakers and the government.

5.1.2. Regime actors

Smith *et al.* (2005) leans on Giddens (1984) when describing that the regime can be either a source of, or structure for, the agency of actors. Stated simply, this can suggest that whether actors are “inside” or “outside” of the incumbent regime is essential in understanding their behavior, and therefore, their options in influencing transitions. As Smith *et al.* (2005) note, there is no straightforward identification of “core regime members” from “non-core members” and outside actors. Literature also finds that to respond to pressures from niches (bottom-up) or the landscape (top-down), or to build up adaptive capacity, regime actors must articulate problems or directions and get involved in networks to share and coordinate resources [6].

We find evidence in the literature that there is a tendency for regime actors to become transition opponents, as “[i]ncumbent regime actors initially tend to downplay the need for transformation” [51] (p. 244). This usually results in friction between members of the incumbent regime and those striving to create regime change through network or coalition resource flow [6]. Geels [19] also discusses the possibility of incumbents forming powerful coalitions to push through a reform agenda that fits their own interests. In summary, we find that although there is a major advantage if the incumbent regime has vested interest in transition, a typical process towards regime change remains mostly uninitiated, and driven by the regime itself. This is confirmed by a number of scholars that see the necessity to include external actors [52–54], also called “outside actors” or “newcomers”, in transition studies. Ceschin [52] draws on an article by Van de Poel, who defines outsiders as actors not included in the present dominant regime, and explains that these actors are needed to foster radical innovation. According to the author, their advantage lies in their distance from current regime institutions and practices. He distinguishes between three groups of outsiders that should be involved in the beginning of a transition process: “firms (because they can mobilize knowledge and financial and managerial resources to develop such alternative innovations); scientists (because they can introduce new designs, criteria, approaches and concepts); and societal pressure groups (because they have the potential to mobilize insiders in the regime)” [52] (p. 4).

5.1.3. Landscape Actors

In examining the literature, we found it difficult to define actors at the landscape level since their definition in the MLP does not allow for it. Nonetheless, we have included this section because of diverging views on this topic among researchers. The landscape, as it is used in the MLP approach,

is defined as a “background”—a scale with no “activities” [55]. According to Raven *et al.* [49], “it provides no room for agency; actors can only respond to it”. Instead, the niche and regime levels compete for supremacy with the landscape as their background [55]. To be more specific, landscape factors include public awareness, government commitments and, for instance, changes in the international economic and financial situation [56]. Even though there are no clear findings for landscape actors, information about the landscape level is relevant in understanding other actors’ roles. Niche and regime actors cannot assert direct influence on the landscape level [38]. However, Coenen *et al.* [55] point out the example of the cut flower production, in which supposedly powerless local actors created new employment norms, and therefore, had major influence on the wider landscape.

Nevertheless, some scholars find that the landscape itself can be seen as an exogenous source of change [38,48]. Changes at the landscape level, for example, have influence on actors from civil society and on their participation in community-based innovative initiatives [57]. What might come close to a landscape actor could possibly be civil society, since civil society “represents and constitutes general landscape-level cultural trends and these can prompt relatively rapid and effective regime changes given the right conditions” [57] (p. 6).

Results from our quantitative analysis show the annual average development of occurrences of specific terms in the context of the specific actor typologies. We analyzed the terms “niche actor/s”, “regime actors”, and “landscape actor/s” of the MLP. While generally exhibiting rather low incidences, we cannot identify a clear positive or negative trend.

5.2. State, Market, Civil Society

A common way to cluster actors is by dividing them into different societal realms. Such realms, such as government or market, will most likely vary in number and compound of clusters. This is exemplified by Grin, who uses the “institutional rectangle”, subdividing society into the realms of “government”, “market”, “science and technology”, and “civil society” [4]. We have decided on classic, simple clusters for our analysis: (1) government; (2) market; and (3) civil society. We will now discuss the general picture that emerges for the role of these actors in sustainability transitions.

5.2.1. Government

As Loorbach [44] stresses, policymaking has become highly complex, especially when dealing with persistent, challenging problems that entail uncertainties due to the presence and wide range of perspectives of a diverse set of actors, and a lack of clear solutions or mechanisms for progress [44]. The general view emerging from the selected articles is that policymakers should create and support room for niches and experiments. Foxon *et al.* [45] state that, although the state generally plays the traditional role of providing financial resources at the early non-competitive state of innovations, it is beginning to fulfill a new role of creating niches through institutional work enabling experimentation [1]. In the case of a Danish local authority, the development of infrastructure and provision of locations for experimentation enabled innovation. This authority could be perceived as a potential niche manager [58,59], a rather new role [58].

The support of niches, however, is a rather difficult task, since policymakers should play an active part without causing inequalities [47]. The case of Bos and Brown [59] demonstrates such difficulties, as engineers taking on the dominant role would place the focus on professional knowledge and utilize heuristic frameworks. Also mentioned in the literature as problematic is that policymakers depend on the wider public for reelection and therefore “seem to follow rather than lead public opinion” [9]. Linked to their reelection, they also depend on the availability of jobs, tax incomes, economic growth, and new technologies. This can cause them to depend strongly on industry, which might lead them to favor industry wishes even when public good is at stake [9].

Even though we find evidence in literature that governmental actors play an important role in niche (development), initiatives towards transitions mostly depend on business communities and on

civil society [60]. Drawing on our findings from the literature, we find that the state strongly depends on the market as well as civil society, but there is also a dependence on consistency in governance support for the development and diffusion of sustainable technological innovations [61]. As we can see from the analysis above, we find a number of studies dealing with the relation of the government *vis-à-vis* niches. We assume that this focus derives from the argument that a relation *vis-à-vis* the regime and the landscape is hard to define. The regime often represents the national scale itself [5], and, as we noted in Section 5.1.3, it is difficult to define the landscape as an actor, and could be defined as a level with no agency.

5.2.2. Market Actors

In the innovation system approach, firms are considered key actors because they bring competitive products and services to the market [61]. Meadowcroft (2009) explains that economic actors connected to established technologies often do not seem eager about alternatives that could interfere with their business [62]. On the other hand, market actors can also be entrants seeking business opportunities or incumbent companies “which diversify their business strategy to take advantage of new developments” [45] (p. 8). Considering a market actor as being part of a niche or being part of the incumbent regime also depends partly on how firms perceive system risks [45], as well as on pressure from other actors, such as policymakers [1] or consumers.

Based on the literature, it seems that a reason that new ideas are not diffusing rapidly through companies may be due to “overarching structures of markets, patterns of final consumer demand, institutional and regulatory systems and inadequate infrastructures for change” [6] (p. 1491). This can lead to limited room for unilateral agency. Referring to Meadowcroft [62], who finds that economic strength can be converted into political influence [62], we assume that large economic actors differ greatly from small- and medium-sized enterprises (SMEs) in terms of the possible impact and influence they can have on transitions.

5.2.3. Civil Society

Although some scholars in the selected literature believe that the role and functions of civil society in transitions are not clearly defined [57,63], they are exemplified by the ability of civil associations to become engaged, and contribute to both regime stability and the pressuring of the regime [63]. As Seyfang *et al.* [57] criticized, the role of civil society has neither been adequately conceptualized nor understood, and the demand-side factors (e.g., consumptions) have been neglected thus far. We find that Brunori *et al.* [48] noted this criticism and state that “innovation policies are mainly addressed at enterprises and are often linked to conventional models of the creation and spreading of innovation”. They claim that “targeting consumers’ networks can add new drivers and processes for innovation” [48] (p. 27). Civil society has been ascribed the following, among other, tasks by Seyfang *et al.* [57]: (1) diffusing innovative niche ideas and practices; (2) using lobbying and protests to unsettle the regime; (3) pushing and encouraging regime actors to seek new solutions from niches; and (4) representing general landscape-level cultural trends [57]. Civil society is a crucial actor in transitions, as evidenced by the following statement: “Ultimately citizens do matter, and through markets and politics they can help to shape the landscape in which the reproduction and transformation of sociotechnical systems takes place” [62] (p. 338). We find evidence in the literature that civil society comprises a broad range of actor groups, and is therefore quite heterogeneous. In order to influence transitions, civil society movements need to reach a critical mass [57].

These findings can be rounded off with data from our quantitative analysis. Figure 3 displays the annual average occurrences of specific terms per article. We have clustered the terms “government/s”, “policy maker/s”, “authority/ies”, “administrator/s and decision maker/s” under the caption “Government”. The caption “Market” includes “firm/s”, “company/ies”, and “corporation/s”, and “Civil society” contains “NGO/s”, “trade union/s”, “political party/ies”, “environmental group/s”,

“interest group/s”, and “household/s”. As seen in the graph, no general positive or negative trend can be found.

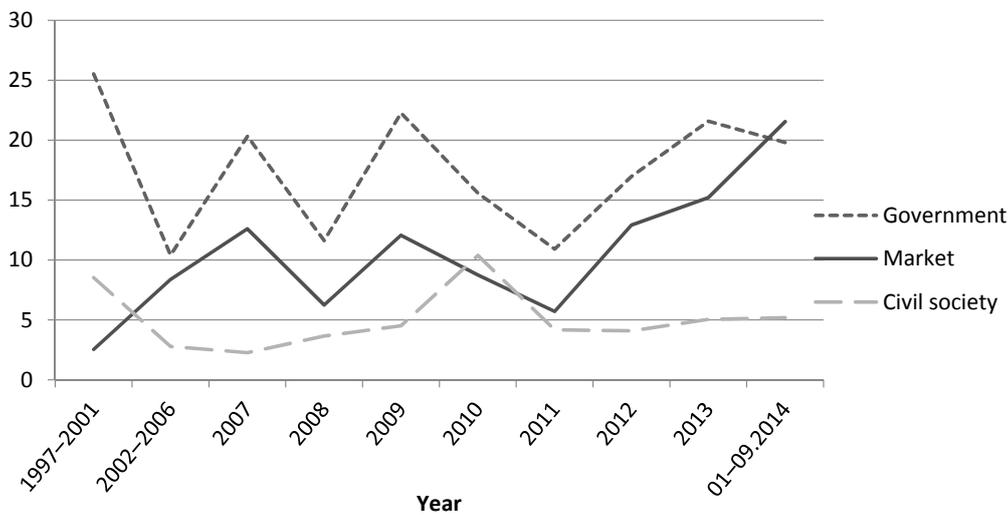


Figure 3. Occurrences of accumulated terms of government, market and civil society in the selected articles (average uses per article). See main text for a definition of the depicted concepts.

5.3. Actors on Different Levels of Governance

Considering actors at different levels of governance can help us to understand their impact on transitions [17]. There is an ongoing discussion about regulatory activities moving away from the national level to global or regional levels [64,65].

5.3.1. Actors on the Local Governance Level

The impact of actors and agency on the local level for sustainability transitions are discussed differently in the literature. Selman [66] argues that “only relatively modest progress can be made by local initiatives, compared with the demand management potential of wider quasi-market and control mechanisms” (p.46). Nevertheless, the author also argues that political acceptability may depend on local consensus, as well as on a positive municipal action, for example, by creating infrastructures. This resonates with Quitzau *et al.* [58], who point out that the role of local policymakers engaged in spatial planning is believed to comprise developing infrastructures and providing locations for experimentation. The advantages of local governance in transitions are exemplified by the Local Agenda 21, for which the municipal jurisdictional areas seem to be important in framing issues of sustainability and the creation of effective policies [66]. On the other hand, the impact of an absence of local governance is illustrated by South Africa’s inability to regulate environmental degradation. The government’s macro-economic strategy and mismanagement at the bureaucratic level led to a lack of qualified public administrators and financial resources to pay for salaries to control air pollution [67]. The literature suggests that local actors, such as participants in community projects, see their greater local knowledge and the “engagement they embody, the sense of common ownership and empowerment, and the social capital and trust that is generated” [50] (p. 3) among them as essential to successful bottom-up approach for energy savings and behavior changes. Considering actors and their agency on the local governance level in respect to transitions, we assume that they have rather weak agency.

5.3.2. Actors on the Regional Governance Level

It is not yet known whether or not local and regional governance can successfully align with global goals [68]. Späth and Rohrer studied the energy regions in Austria and found that regional

actors often face limited opportunities for creating change. This is because “no laws can be changed; legal enforcement of action is hardly possible; administrative capacity is limited; many core actors and elements of the incumbent energy system are simply out of reach—large-scale generation and network facilities, regulation, *etc.*” [69] (p. 456). Linking with national or global actors may offer regional actors increased legitimacy and additional access to resources. As Späth and Rohrer [69] show, drawing on cases of successful regional transitions may be useful to national and global actors. They can use these best practice examples to promote transitions on a broader scale. The authors also find that actors can achieve the greatest impacts with the help of their human and institutional capital [69]. To transform a new technology from experiment to reality, the support of regional planning and policy initiatives is needed [70]. Accordingly, Hillman [64] finds that local initiatives depend on linkages with policy arenas on a higher level in order to be able to scale-up.

5.3.3. Actors on the National Governance Level

In examining the literature, we find a focus on the government as an actor at the national governance level. Raven *et al.* [49] find that almost all case studies dealing with socio-technical transitions take place in a national setting. As some cases demonstrate, the probability of successfully managing transitions depends on national actors (such as, for example, ministries or government agencies) and their real and perceived power [71]. Tension may arise when local authorities set themselves higher goals than the national government sets. Selman [66] suggests that capacities leading to transitions are quite different between the local and national levels. The government has the potential to organize key resource flow efficiently. This can be done by managing flexibly targeted supply and pricing strategies due to the aforementioned national policy and fiscal measures [66]. Some authors find that entrepreneurs and governments that seek to establish markets for sustainable innovation start at the national scale but eventually try to distribute the innovation at the global scale [61].

5.3.4. Actors on the Global Governance Level

Global governance comprises forms such as multinational regulations, that can guide transition processes [72]. We consider actors such as NGOs, multinational companies and international organizations as actors on the global scale, so far, as they act on the global level, e.g., participating in international conferences or the enactment of international regimes. Due to the globalization the number of transnational organizations has increased in recent years [73]. However, the literature specifically on actors on the global governance scale in the context of transitions is rather scarce. Pahl-Wostl *et al.* find that “there is no system of global governance that can manage environmental issues successfully” [68] (p.40). Specifically, international organizations are sometimes perceived as not being most effective or even failing [74] at solving environmental problems. Pahl-Wostl *et al.* for example try to explain this with the challenge that “real human experience of environmental change is normally felt locally and global changes, especially those of climate, are essentially perceived as unreal because they are represented as statistical averages (Hulme, 2010), or as modeled future scenarios, with the latter often failing to present information about the locally or regionally most relevant climatic factors” [68] (p. 40).

5.4. Intermediaries

A number of scholars find that intermediaries can play a special role by providing and distributing necessary information in a transition [50,75]. They can include very different types of organizations, such as NGOs and government or semi-government agencies working at different scales [75]. However, as our analysis shows they do have one common feature—their mediating function. Hodson and Marvin [75] have elaborated that first, the intermediaries mediate between the production and consumption; second, between the different priorities and levels of funders, regulators, *etc.*; and third, between the different applications in creating a vision. They also find that there is quite a variety in

services intermediaries can provide, such as the provision of energy advice and advice centers; project initiation, management and coordination; consultancy activities; lobbying; education; training and courses; and network building.

In a recent study about solar initiatives, the authors found that these initiatives have developed to compensate for coordination deficits (insufficient knowledge and still-unknown user profiles) in market formation [76]. With their understanding of the early market formation stage, they have become central intermediary actors [76]. Another example, the Rathenau Institute, is an independent institute that began by advising the Dutch Parliament on science and technology issues. It provides a mixed discursive sphere, bringing together a variety of actors [77]. Intermediaries, such as local and national energy agencies, provide technical advice to connect different actor groups and help new ones access resources and networks [78]. McCauley and Stephens [70] see the role of intermediaries in the MLP as “connecting niche-level activities with regime level institutions”. They also see the potential of intermediaries to diffuse new technology and practices through the regional level [70].

5.5. Supporting and Opposing Actors

We find two different perspectives on actors and agency in transitions. One perspective states that primarily larger networks and collective action take the lead. The other perspective focuses on actors, which can be organizations or individuals, playing key roles [59,60,79]. Thus far, the literature does not show any general patterns in the appearance or presence of such key actors. The absence of a key actor does not necessarily seem to lead to failure of a transition, but a presence of one does seem to foster and support it.

There is little information on actors opposing a transition. We would have expected a much greater interest in the topic, since there are numerous cases where opposing actors appear, as in the case of the energy transition with anti-wind farm actors or organized climate skepticism [63]. Traditionally, incumbents are expected to be an opposing force [1,46,51] and new actors a supporting force of transitions [1]. Typically, the old elite authority is confronted with civil society as the opposition [46]. Smith [63], however, sees civil society as a potential opposing or supporting force in transition processes. For instance, while environmentalists are supporters of energy transition, actors in other areas of civil society are indifferent. These actors can become opposing forces when “pushed unreasonably and too far” [63].

Understanding the interests and power of actors helps classify them as supporters or opponents [1,19]. Almost all “opposing strategies” seem to resemble strategies that supporters also use, such as disseminating their ideas, building coalitions, and controlling various decision-making forums. Meijerink and Huitema also find that “proponents of policy change typically do not employ underhanded strategies” [80] since they have access to resources, such as bureaucratic delay and obstruction. A specific actor type can potentially bear the role of a supporter as well as an opponent. Niche actors, for example, can have supporting functions, such as creating a starting point for a systemic change, but they can also save the system from collapse. Another example is market actors, whose position strongly depends on their business interest, as well as risk calculation. Support will most likely come from incumbent companies that are diversifying business strategies and therefore trying to take advantage of new developments. Furthermore, new entrants looking for market entries will likely support a transition. Opposing forces, on the other hand, can include incumbent companies connected to established technologies (see also Section 5.2.2).

There can be moderate as well as radical forces in either group. Depending on their balance of power, these forces can influence decisions, cooperation, processes and the development of a transition [45,46].

5.6. Functions, Dependencies and Agency

5.6.1. Functions

We identified a number of functions each actor fulfills in a transition (Table 1). We were able to identify several overlaps in between these functions. Actors on a regional governance level, civil society, as well as intermediaries, promote and diffuse new (niche) ideas. It is important to mention that intermediaries can promote these ideas at the regional level. The regional governance level provides examples of successful regional transitions, which can then be pushed to a broader level. We also found that the local governance actors and the government are important for niches: local governance actors can be niche managers and the government can enable a niche creation through institutional work. We also found overlaps between actors on the national governance level and the government. Both are relevant in respect to resources, the latter one is important since it provides financial resources at a very early stage of a transition. National governance actors are said to organize the key resource flow efficiently by managing flexibly targeted supply and pricing strategies. Lastly, it is important to mention that functions of a certain actor can change over the course of time, as we see in the government's traditional function of providing financial resources, and in its new role of creating niches through institutional work. Changing actor roles are also illustrated by the case of solar initiatives, which demonstrates that the role (e.g., membership structure and functions) of social initiatives changed tremendously when entering the bridging market stage. As Dewald and Truffer (2012) found, their assigned functions as intermediaries were taken over by professional actors and networks [76]. The case of solar initiatives is not the only one underlining the changing actor roles. A multiple case study by Bai *et al.* [81] also find that actor roles change over time "especially when stage and mode of project execution changes" (p. 320). Furthermore, Kemp *et al.* [17] find that "actor roles will change over time endogenously (as part of the development process). For instance, in the course of an energy transition process, oil companies may decide to become energy companies" (p. 6). This is further supported by Grin *et al.* [54], who explain that during the course of a transition, actors change their interests, preferences and even their identities. Grin [4] also points out that agency is pivotal in particular episodes of a transition. Concluding from these cases, for us it seems that each actor type must be defined for each phase of the transition process. One proposed temporal path of transitions shows a four-phase development: predevelopment, takeoff, breakthrough and stabilization [12].

5.6.2. Dependencies

We find evidence in the literature that actor functions and their dependencies between each other are strongly connected because actors can also depend on the fulfillment of certain functions and actor roles. Not surprisingly, there are dependencies in between actors belonging to one typology, but we also identified few dependencies between actors from different actor typologies. All in all, almost every actor depends on other actors in one way or another.

Examples we find in the literature are dependencies between actors from different typologies such as niche emergence, which can depend on the government for changes in policy and support. The regime can depend on actions and behavior of civil society since they can unsettle or stabilize it. However, scholars also find that civil society depends on reaching a critical mass in order to create change. Another example of dependencies between actors from different typologies is between niche and market actors. Niche actors can create new markets and their role also includes entrepreneurial activities.

Table 1. Functions, dependencies and agency of different actor typologies.

Type	Actor	Function	Dependencies on Other Actors and Resources	Potential Influence on Transitions
MLP	Niche actor	New, radical social and technological ideas emerge, Knowledge development and diffusion, articulation of visions, entrepreneurial activities, market formation, guidance of search activities, mobilization of resources, creation of legitimacy, overcoming of resistance to change, Can create a starting point for systemic change	Successful niche emergence depends on changes in government policy and support	Niche level is a protective space which supports more agency, niche actors have limited agency
	Regime actor	Supporters of transition by forming powerful coalitions to push through a reform agenda that fits incumbent regimes interest. Opponents of transition by downplaying the need for transformation	In order to build up adaptive capacity, regime actors must articulate problems or direction and get involved in networks to share and coordinate resources.	The regime level itself can be either a source of or structure of agency, regime actors have limited agency
	Landscape actor		Changes at the landscape level have, for example, influence on civil societies participation in community-based innovative initiatives.	No activities; level itself provides no room for agency
State, market, civil society and citizens	Government	Traditional role of providing financial resources at the early non-competitive state of innovations, New role of creating niches through institutional work enabling experimentation	Depend on job availability, tax incomes, economic growth and new technologies, depend on the wider public for reelection	Limited agency (often perceived as leading actor in transitions)
	Market	Bring competitive products and services to the market, Supporters of transition when being entrants, seeking new business opportunities. Opponents of transition when business with established technologies, not eager about alternatives	Consumer pressure	Limited room for unilateral agency: reasons for new ideas not spreading-overarching structures of markets, patterns of final consumer demand, institutional and regulatory systems and inadequate infrastructure for change
	Civil Society	Ability to get engaged to both regime stability and the pressuring of the regime. Pressuring of regime: diffusing innovative niche ideas and practices, using lobbying and protests to unsettle the regime, pushing and encouraging regime actors to seek new solutions from niches, representing general landscape-level trends	Through markets and politics they can help to shape the landscape civil society can unsettle the regime or contribute to stability	Limited, for example, by reaching a critical mass

Table 1. Cont.

Type	Actor	Function	Dependencies on Other Actors and Resources	Potential Influence on Transitions
Actors on different levels of governance	Actors on the local governance level	Framing issues of sustainability and the creation of effective policies. Successful bottom up approaches for behavior changes. Might create local acceptability for certain national policies and fiscal measures. Developing infrastructure and providing locations for experimentation. Niche managers	Local initiatives depend on linkages with policy arenas on a higher level to be able to scale up.	Limited (see also actors on the regional governance level)
	Actors on the regional governance level	May help to promote transitions on a broader scale when national/global actors can draw on successful regional transitions (dependency). Helps to transform a technology experiment to reality	Achieve the greatest impacts with the help of their human and institutional capacities.	Weak agency. No laws can be changed. Legal enforcement of action is hardly possible. Administrative capacity is limited. Many incumbents are out of reach
	Actors on the national governance level/Government	Organize key resource flow efficiently by managing flexibly targeted supply and pricing strategies. Can establish markets for sustainable innovation together with entrepreneurs (also dependencies)	Managing transitions depends on national actors and their real and perceived power	Leading or structuring actor
	Actors on the global governance level	Can guide reform processes enacted by the government. Priority for governing seems to be wealth accumulation	National governments have partly given up political and economic sovereignty to multinational corporations and financial institutions.	Limited agency
Intermediaries		Providing and distributing necessary information. Mediating function. Provide services. Connecting niche-level activities with regime-level institutions. Diffuse new technologies and practice through the regional level	Resource dependency	Active agents

Dependencies between actors from the same typology can be found by looking at the typology of “state, market, civil society” where we find several dependencies. Not only does the government depend on the market for jobs, tax income and new technologies, but the government can establish markets for sustainable innovation together with entrepreneurs. The market is influenced by consumer demands. The typology “levels of governance” illustrates that actors on the local governance level can only scale up by connecting to higher levels in the policy arena. Actors on the regional governance level may help to promote transitions on a broader scale when national/global actors can draw on successful regional transitions. National actors depend on global actors, since nations partly give up political and financial sovereignty to multinational corporations and financial institutions.

5.6.3. Agency

It is interesting that we were able to identify two types of actors having weak or no agency. These actors include actors on the landscape level and actors on the local governance level. While we would like to re-emphasize that the definition of actors on the landscape level is very difficult and controversial, these findings about weak or no agency of actors on these levels possibly suggests that the reason for it lies in the size of the scale. The local governance scale is a micro scale whereas the landscape level is at the other extreme, on a macro scale. Both seem to be rather extreme ends when compared to micro, meso and macro scale. Table 1 shows that almost all actors have limited agency, which can be partly explained by their dependencies. This, as well as the positive trend of the term “network/s”, which we discovered in our quantitative analysis, demonstrates that it is crucial for different actors to link up for solving current problems. This can also give us an idea about network governance, and its importance for transitions. Loorbach [82] also supports this aspect by explaining that “the accumulation of knowledge, capital and skills in social networks has led to increased social agency that is more and more independent from institutionalized and centrally coordinated forms of policy making” [82] (p. 38).

6. Discussion and Conclusions

Actors and agency are believed to be important elements in transitions. The research area is broad and very heterogeneous, and our quantitative analysis has shown no clear positive or negative trend in the development of annual average occurrences of either system- or actor-based terminology. This analysis, and the methodology used, does not provide comparable numbers. Nonetheless, the data collected can illustrate developments of specific terms over the course of time.

In the literature on (sustainability) transitions, we identified the following actor typologies:

- a Systemic typology: Multi-level perspective (niche, regime, and landscape actors)
- b Institutional typology: State, market, civil society
- c Governance typology: Actors on the local governance level, actors on the regional governance level, actors on the national governance level, actors on the global governance level
- d Intermediaries.

We have identified the systemic level as a way to cluster actors in transitions, as in the case of the MLP, in which actors are joined on the niche, regime, or landscape level. Drawing on a more institutional approach, actors are grouped in the social realm to which they belong. We also find actors on different levels of governance, such as municipalities, administrative districts, national governments, and international organizations. The three typologies cannot be used interchangeably, but we find that there are overlaps between them when looking at certain actors (Section 5.6). Roles and functions of actors vary, depending on the time and phase, respectively, of the transition. We have not included the temporal scale in our qualitative findings, but including it in an overall complex actor typology is crucial. We suggest considering the four transition stages in order to define an overall temporal scale for the creation and design of a comprehensive actor typology in transitions. We have also not included the spatial scale, which has been neglected in the transition discourse [39,55]. Since

the spatial or geographical approach has only recently been of interest, only a highly fragmented picture would have been presented. The MLP, in particular, has been criticized for not properly addressing the actual places in which transitions take place [55,70,83]. There is no territoriality or scale tied to niches, regimes, or landscape. A similar perspective can be found in Technological Innovation Systems (TIS) that understand the spatial scale as “global opportunity sets” to which all actors can have access [55]. Recognizing these criticisms of MLP and TIS, research about these two frameworks seeks to further advance these perspectives.

Our qualitative research has not only shown that there are different actor typologies in transitions. We have also made clear, by examining functions, dependencies and agency, that these typologies are strongly interconnected. We conclude that actors in transitions can be part of several different categories, which can change over the course of time. Considering the reintroduction of Governance Panarchy in transitions [82] we propose to consider changing actor roles (functions, dependencies, *etc.*) in a comprehensive actor typology for transitions. As Loorbach explains in his work, “new technologies enable individuals to shift between networks, communities and governance contexts in which different types of institutional and governance regimes are present.” [82] (p. 50–51). This suggests that a comprehensive actor typology for transitions will need to consider these dynamics.

We see a possible connection between our findings of changing actor roles and of our quantitative analysis of key words in the literature, which has shown a positive trend in the development of the term “network/s”. Networks might be able to support the development of a transition. They could provide the necessary linkages when actor roles change, and the establishment of new connections or information channels, *etc.* becomes important, for example, when actors are gaining or losing key functions or access to resources. In a globalized world we could imagine that changes in actor roles are also accelerated, and therefore, the necessity for networks becomes more urgent.

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Abbreviations

The following abbreviations are used in this manuscript:

MLP	Multi-level perspective
SNM	Strategic Niche Management
TM	Transition management
SME	Small-and medium-sized enterprises
TIS	Technological Innovation Systems

Appendix A

Top 10 terms for actor-related cluster: actor/s; corporation/s, firm/s, company/ies; government/s; group/s; organis/zation/s; individualist/s, individualistic, individual/s, person/s, individual actor/s; stakeholder/s; institution/s; consumer/s; people.

Top 10 terms for systems-related cluster: system/s; regime/s; niche/s; path/s, pathway/s; evolutionary, evolution/s; landscape/s; transformation/s; diffusion/s; emergence; lock-in/s.

Appendix B

Figure A1 Accumulated (1995–09/2014) average occurrence of the top 40 terms per article.

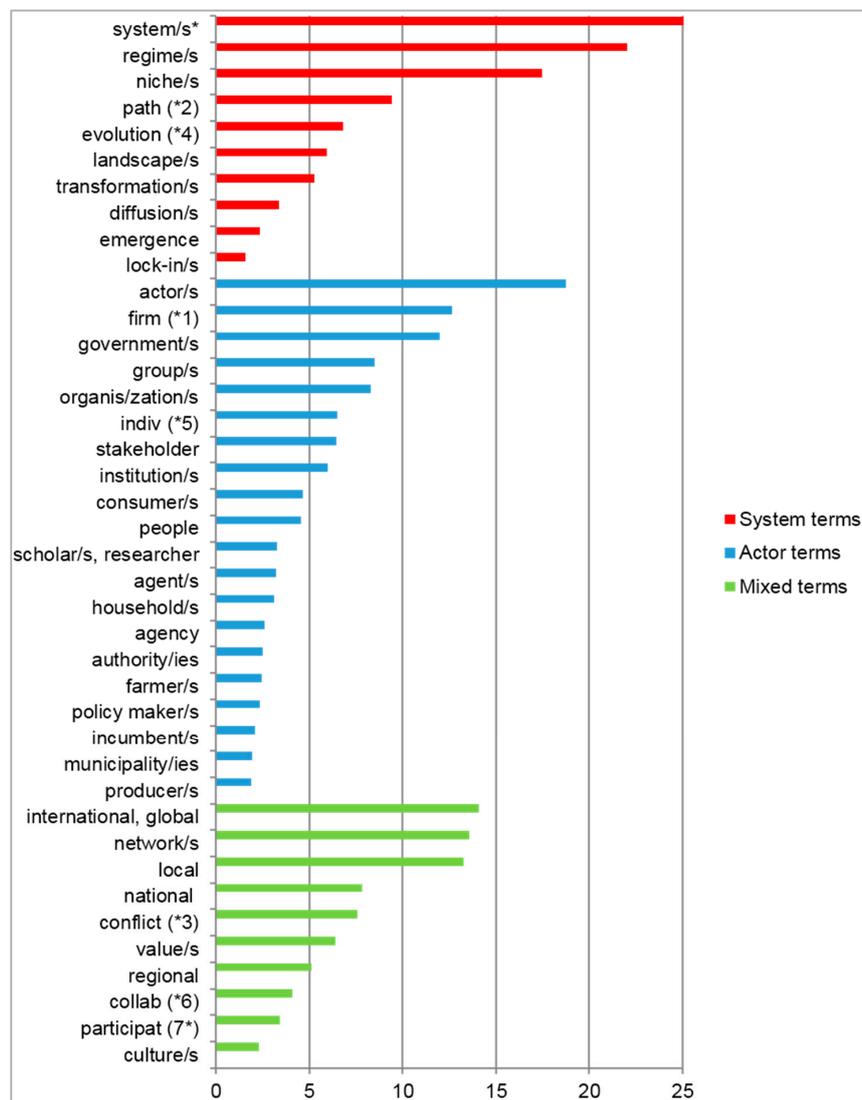


Figure A1. Accumulated (1995–09/2014) average occurrence of the top 40 terms per article. (* For a better graphical illustration, the following changes were made: the search term *system/s* was shortened. The absolute number is 47.2. The search words in *firm (*1)* consist of the words: “firm/s”, “company/ies”, “corporation/s”. *Path (*2)* consists of “path/s” and “pathway/s;” *conflict (*3)*, of “conflict/s” and “conflicting;” *evolution (*4)*, of “evolution/s” and “evolutionary;” *individ (*5)*, of “individualist/s”, “person/s”, “individual/s”, “individual actor/s”, “individualistic”. *Collab (*6)* consists of “collaboration/s” and “collaborative;” *participat (*7)*, of the terms “participatory” and “participation”).

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