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Path Dependence in Complex Systems
The Case of Regulation Practices in Ambulatory Healthcare

A Short Essay

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Abstract

The investigation of path dependence in complex systems usually leads to several methodological and theoretical problems that are not all solved by now. Based on an empirical case study in ambulatory healthcare, I suggest a model to capture path-formation and path-breaking developments on different system levels. The model is based on the components “agency”, “dynamic”, “system”, and “structure” to set empirical phenomena in a circular relation. It is expanded by an “agency-realm” and an “institutional-realm” to tackle the recursive interplay between the different system levels. Additionally, the model is used to align different theoretical approaches that are necessary to investigate path dependence in complex systems.

Introduction

I am pleased to have the opportunity to discuss some aspects of my PhD thesis in this short paper. I have chosen an essay-like form of writing to share some insights and problems that usually occur when path-dependent processes are under investigation in complex systems.

The empirical case study is situated in the German health care system. A two-part process is being investigated. In the first part, path-dependent regulation practices which have developed among the relevant actors in ambulatory healthcare provision are reconstructed in a historical view. In the second part, the emergence of path-breaking regulation practices is investigated exemplified by two physician networks.

What do I mean by regulation practices? For example the referral of patients, certain information flows between the actors to coordinate care provision, or the way in which different healthcare professions organize their collaboration. In short, the focus lies on things that happen in-between organizations and persons. Therefore, these practices are considered as a form of agency which is profoundly social and collectively built by actors located on different systems levels.[1]

To be able to distinguish between path-dependent and path-breaking regulation practices, the two phases are specified: In the first phase, actors are following and reproducing a "fragmentation-logic". This means healthcare services are produced separately (e.g. inpatient vs. outpatient), with less interprofessional collaboration and a poor information flow between the actors. In my study, the emergence of path-dependent regulation practices is strongly related to an institutional dominance of the medical profession which has led to practices and structures that are mainly centered on physicians.[2]

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[1] "But I do see agency as profoundly social or collective. The transpositions of schemas and remobilizations of resources that constitute agency are always acts of communication with others. Agency entails an ability to coordinate one's actions with others and against others, to form collective projects, to persuade, to coerce, and to monitor the simultaneous effects of one's own and others' activities. Moreover, the extent of the agency exercised by individual persons depends profoundly on their positions in collective organizations" (Sewell 1992: 21).

[2] Although not explicitly building on theory of path dependence, Reay et al. (2005) are discussing the "recomposition of an organizational field" in healthcare which was made possible because actors deviated from the dominant logic of medical professionalism. In another study, Reay et al. (2006) have found "microprocesses of change" in healthcare which occurred because the relevant actors (although deeply embedded) were able to legitimate new inter-professional collaboration.
In many healthcare systems healthcare provision is unquestionably dominated by medical actors across the different system levels (Freidson 1979, Göckenjan 1985), or with Fredericks et al. (2012: 128): „The tradition of medical power and authority is one that is socially constructed and is historically embedded in the functioning of health care organizations and our expectations, actions, and interaction as patients and health care providers". The strong position of the medical profession in healthcare is one reason for the occurrence of path-dependent regulation practices. This is true for many reasons I cannot discuss here in detail. Just to mention two of them: The disciplinary separation of the profession and a doubled infrastructure of medical specialists, unique in Germany, have not only led to a fragmented organizational development but also to fragmentation in the inter-actor regulation across certain sectors. Such a system easily becomes inefficient when for example complex healthcare tasks have to be managed.

In the second phase of the process, a so-called "integration logic" comes to the fore. Here, networking is considered to have the capacity to span formerly separated parts of the system.

For my study, different data sorts have been collected from individual actors like healthcare providers (GPs, specialists, nurses, therapists), financiers (health insurance funds and private enterprises) and from collective actors (e.g. medical associations and the local government). To reconstruct the historical process (1920s until today), historical studies, archival and interview data and a descriptive network analysis is used. In a theoretically informed analysis I ask for reasons and mechanism that have led to the emergence of path-dependent and path-breaking inter-actor regulation practices in ambulatory healthcare.

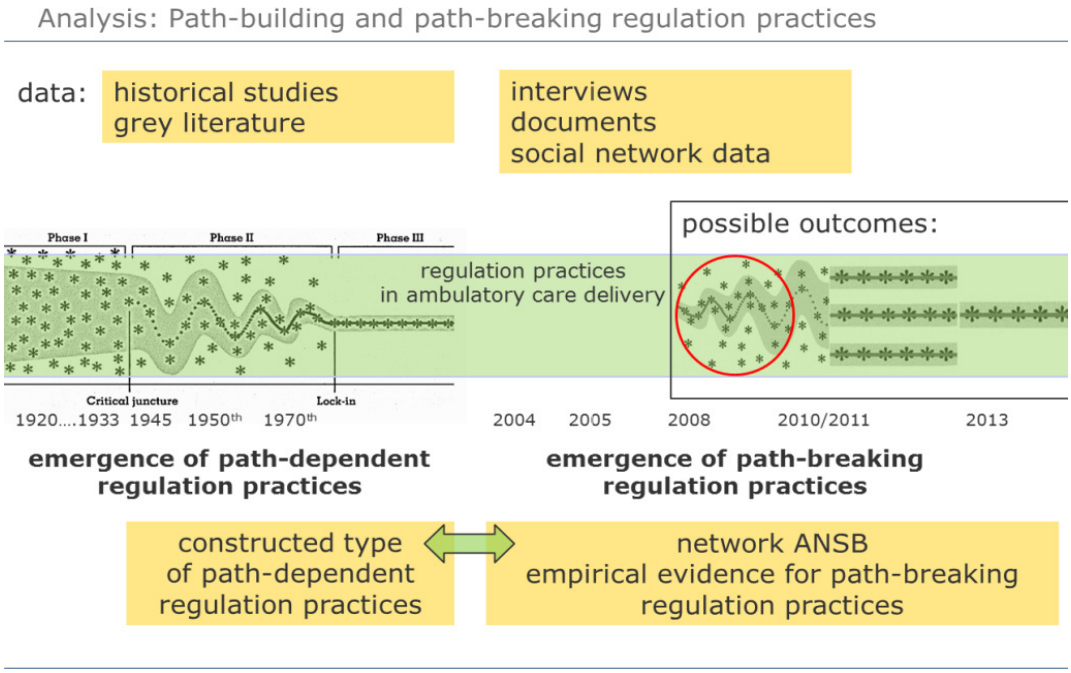

Fig. 1: Research process in two phases [ANSB is a physician network].

Based on the historical data, a "constructed type"[3] of path-dependent regulation practices is used to contrast the emerging path-breaking regulation practices in the two physician networks.

But instead of presenting any findings, in this short essay I would like to discuss my basic model for capturing path-dependent and path-breaking processes in complex systems. In perspective of the conference to come, it would be interesting to share some experiences of how to deal with complexity in research projects on path dependence. This is a relevant topic because empirical path research is per se a complex issue that needs at least two

[3] „A constructed type is a purposive planned selection, abstraction, combination, and accentuation of a set of criteria that have empirical referents and that serve as a basis for comparison of empirical cases" (McKenney, 1957: 200 cited from Janoska-Bendl, 1965: 63).

perspectives: The view from within on a changing (social) phenomenon and an "external lens" (Sydow et al. 2009: 702) to judge things that are going on.

Capturing Path Dependence in Complex Systems

However, what does complexity means? It is the healthcare system itself where complexity exists towards three dimensions. The first one is the multilevel constitution of ambulatory healthcare where different professions, health insurance funds and other "individual actors" regulate their collaboration in ambulatory healthcare provision. These regulation practices are embedded in a higher-level system represented by "collective actors" like the medical associations (Ärzteverbände), the regional Associations of Statutory Health Insurance Physicians (Kassenärztliche Vereinigungen), and other healthcare authorities on the regional, state and federal level.[4]

The second dimension of complexity is that multiple actors influence each other horizontally and vertically. In doing so, they produce a stream of events which recursively shapes the regulation practices in a certain manner (fragmentation/integration). From a path-theory perspective, some of these events have been "small events" that influenced the direction of path-formation. There also have been "triggering events", and some of them can be treated as "critical events" for the entrance in the lock-in phase. As in every study dealing with path dependence, the challenge is to choose events and get them into the right order without assuming a strict causal relationship.[5]

And the third dimension is time which is needed for decision-making in healthcare policy, for power-struggles and the actors' adjustments. So to say, time is needed for path formation. In the German healthcare system path formation does not happen abruptly because change is usually facilitated by the interplay of various embedded actors. Even when a certain law is passed, the self-government (Selbstverwaltung) can delay or even hinder its implementation. This makes healthcare an interesting object for applying path-models.[6]

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[4] In this study, embeddedness is taken for both a constraint for behavior (with structural, cognitive and political mechanisms at work, cf. Dacin et al. 1999) and, especially in the second phase of a process, as an enabler for change that emerges from within the system (cf. Reay et al. 2006).

[5] "The observational world does not usually provide cases with both temporal variation (making possible 'pre' and 'post' tests) and spatial variation ('treatment' and 'control' cases) across variables of theoretical interest, while holding all else constant. What this means is that case study research usually relies heavily on contextual evidence and deductive logic to reconstruct causality within a single case" (Gerring 2007: 172).

[6] Contrary to Brown (2010) and Rico/Costa-Font (2006) who explicitly deny the explanatory power of theories of path dependence in healthcare policy research, I believe that models like the *Berliner Modell* (Sydow et al. 2009) can fruitfully be used to not only to structure long lasting (political) processes with multiple actors but also to include complementary theories in an encompassing model of investigation. By such a "meta-modeling" it becomes also possible to include power-related explanations like the influential position of the medical profession in healthcare.

As you easily can imagine these complexity issues are leading to various theoretical and methodological problems that are not all solved yet.[7]

Against this background, and before introducing my model, I would like to ask some simple but challenging questions regarding the investigation of path dependence in complex systems:

1. Where can path dependence be located, and does it stay stable?
2. What drives the process on?

The first question contains several aspects that are worth thinking about. First, who or what is path dependent? Is path dependence in complex systems like healthcare connected with persons, organizations, certain routines and practices, or maybe with certain artifacts? Second, once path dependence is located, let's say a certain routine has become path-dependent that gets applied on some level in a given system, how is it possible to distinguish between path-depended and non-path-dependent elements? One can ask this question from a network theory perspective: Is it possible to define borders of path-dependence, or is path-dependence a somehow frayed phenomenon?

I would like to give an example from my research: Let's suppose the referral of patients follows a certain logic that has become path-dependent. In complex systems, one has to ask for the elements in which this form of agency is embedded. For example the medical fee schedules (Gebührenordnungen) for the remuneration of services. With respect to the practice under investigation, this would be a macro-located element where other actors (beside the practitioners) are influential. At the same time a micro-located element, like the individual orientation of a doctor, could have become path-dependent. But GPs (Hausärzte) and specialists (niedergelassene Fachärzte) are usually embedded in formal and informal collegial networks. So the question is: What elements of a certain referral practice have become path-dependent?

Another aspect of locality is the "topographical stability" of path dependence. With regard to the time dimension, one could ask if path dependence stays at the same place. Does a lock-in need a place-dependent pattern of relationships like some economic geographers argue?[8] Or maybe path dependence moves around, from one system level to the next or from one actor to another?

These questions come along with methodological and practical problems of how to trace back a path through time when the process is multilevel and maybe not stable in place.

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[7] For an overview of the "constitutive features and potential indicators of paths" see also Sydow et al. (2012: 5). The authors are claiming that path-dependent processes are recursively (cf. Giddens 1984) produced in all phases of the process which also includes later phases that go beyond the lock-in. Additionally, they apply a constructivist perspective on path-building processes. Both perspectives are compatible with the basic model that I use.

[8] Martin & Sunley (2006) are discussing the regional conditions of the development of path dependence. They promote a model of positive lock-in triggered by strong ties of the regional actors that can flip to a phase of negative lock-in where the weakness of strong ties comes to the fore (see also Grabher 1993).

From this point of view, a fuzzy shaped path is more likely than clear boundaries and a stable set of actors.[9]

To capture path dependence in complex systems, a model is needed that is able to integrate multiple levels (and actors) and their circular interplay over time. This leads to the second question of what drives the process on.

In the *Berliner Modell* (Sydow et al. 2009), self-reinforcement mechanisms are seen as the motor that drives an organizational path towards a lock-in. In this process, the actors' capacity to act "off-path" continually declines although contextual factors are not explicitly included.[10] Of course path-research informed by institutional theories or network theories have already applied an extra-organizational perspective.[11]

In my model, path-formation is also explained by applying an external perspective. This view is necessary because regulation practices in ambulatory healthcare are influenced by different actors located on different levels of the healthcare system. But what drives the process on? In my view, the necessary momentum for path-formation is given exactly by the interplay between these actors located on different system levels. In other words, the multi-level constitution of the ambulatory healthcare system designed around the medical profession not only provokes and stabilizes fragmented delivery structures but also increases fragmentation over time. This fragmentation logic has become the guiding and ruling principle that also affects the inter-actor regulation in healthcare delivery which is a crucial part of the delivery system. Most of all, coordination effects are seen as the main driver of the process.

The Model

The fundament of the model contains four parts: *System* (system), *Struktur* (structure), *Handeln* (agency) and *Dynamik* (dynamic) are circularly connected. Additionally, two opposite pairs (system vs. agency and structure vs. dynamic) do comprise the phenomena that can be possibly observed:

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[9] With regard to punctuated equilibrium, Djelic & Quack (2007: 181) emphasize the multidirectional and frequent recombination of so-called "episodes" in which paths slowly unfold over time. In complex systems like healthcare with highly embedded actors, a radical shift from one state to another seems unlikely. Various path-building and path-breaking episodes have to be assumed.

[10] "In our view four mechanisms in particular are likely to contribute to the development of organizational path dependence: coordination effects, complementarity effects, learning effects, and adaptive expectation effects." And with respect to embeddedness: "further research [is needed] to explore the contextual conditions enhancing (or hindering) the unfolding of selfreinforcing mechanisms and subsequent constitution of organizational paths." (Sydow et al. 2009: 698 and 701).

[11] Pierson (2000: 263) opens path theorizing towards the "features of political life" where collective actions do facilitate path formation. Crouch and Farrell (2004) are expanding the perspective by applying multiple institutional settings in which the actors can operate. Kim et al. (2010) are adding a network and an organizational field level where inertia can be observed.

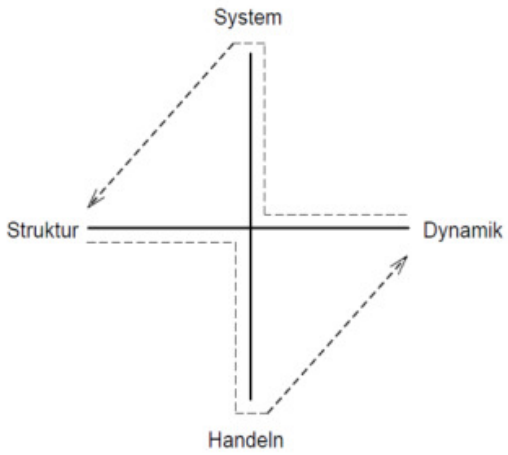

Fig. 2, basic model (Mayntz 1997: 28).

Agency: I would like to start discussing agency related to efficiency which is crucial in path theory. Here, agency can be defined towards two extremes: From a solely external perspective a certain kind of agency could be judged as inefficient related to a previously defined benchmark, and unsatisfactory agency could be removed. From a solely internal perspective when only the actors are taken into account, agency – although influenced by external factors – could hardly be attributed as path-dependent. In the model, agency is considered as twofold and observed likewise from an internal and external perspective.[12] In figure 2, agency is directly linked with system (static view). But agency is also connected with systems via structure and dynamic (circular view).

Dynamic: Path-theories are process-theories and depending on the theoretical point of view, institutional, organizational or agency-related explanations are seen as the adequate approach. But all of these approaches have something in common: They are all devoted to negative or positive dynamic processes – positive when heading towards a lock-in and negative when stabilizing a given status. Therefore, dynamic is a central feature for the investigation of path dependence. For example in the *Berliner Modell* every of its three phases is driven by another dynamic. An additional path-breaking phase is also characterized by its own dynamic. However, the interplay between agency and system can only be understood when the dynamic processes can also be modeled over at least two system levels.

Structure: In my model, structure serves as a link between the institutional setting (system) and the regulation practices of the actors in ambulatory healthcare (agency). Structure is seen twofold as an outcome of social interaction and as a medium for the collaboration of the actors.[13]

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[12] Cf. Ackermann (2001: 164) who accounts for both, an external appraisal criterion (*externes Beurteilungs-kriterium*) for path dependence and an internal one.

[13] „Hence, […] the notion of structure does not refer to the context of social action as detached from this action, but is considered an outcome and a medium of action" (Sydow/Windeler 1998: 270).

System: Like agency, system is not modeled as a monolithic block, but it is seen as recursively produced. With regard to the development of path dependent regulation practices, norms of reciprocity among the relevant actors have stabilized their expectations and collaborations towards a certain logic.[14]

In the model, all of the four features are circularly connected. A recursive relationship between an "action realm" and an "institutional realm" expands the model (see Fig. 3). The action realm contains regulation practices among the individual actors which can be related to agency and/or structure. For example, an interprofessional practice like the delegation of certain tasks to nurse practitioners belongs to agency whereas an IT-system to coordinate information exchange can be related to structure. The institutional realm contains the collective actors that have an impact on the regulation practices in the action realm.

The action realm and the institutional realm are connected by multiple exchange mechanisms. The four pairs (system-agency, structure-dynamic, agency-dynamic, system-structure) are used to analyze path formation and path-breaking development. System and dynamic are located in the institutional realm because the German healthcare system is a highly regulated one and usually dynamics occur when made possible by legislation (top-down). Not so often, certain changes in the action realm are able to modify the behavior of the collective actors. In short, duality in the relationship between the action realm and the institutional realm is assumed.

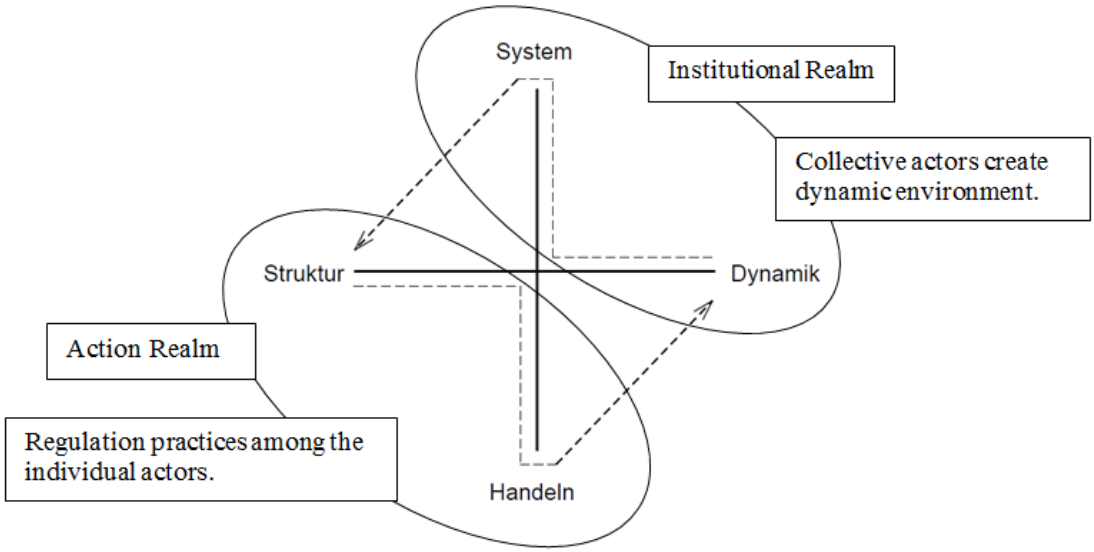

Fig. 3, the model is based on Mayntz (1997: 28), Barley (1986: 82), and Jarzabkowski (2008: 624).

[14] Using norms of reciprocity (Gouldner 1960) actors can stabilize their collaboration over time. These norms go beyond confidence-building, instead they implement a collective logic that includes not only trust but also elements like autonomy and dependence or control (Sydow/Windeler 1998: 267). In the field of healthcare collective actors like the regional Associations of Statutory Health Insurance Physicians (Kassenärztliche Vereinigungen) are able to implement such norms when individual actors are willing (or have) to collaborate.

The model can be used to explore path-dependent regulation practices that sustained fragmentation in healthcare delivery and for the investigation of the emerging path-breaking inter-actor regulation. The model can also deal with the complexity in healthcare because fragmentation and integration are seen as the result of the interplay between the institutional realm and the action realm.

Necessary Theoretical Expansions

For the investigation of inter-actor regulation practices in a complex system, further theories have to be integrated. First, a definition of agency is needed that takes into account that context and a specific historical legacy are relevant for practices formation. Practice theory can help to capture what embedded actors are doing without neglecting their past.[15] In my study, only practices that mutually constitute fragmentation or integration in ambulatory healthcare provision are relevant. Practice theory allows for a specific operationalization.

Second, network theories are applied that take into account an actor-specific view.[16] Networks (informal and formal) of professionals are spanning different levels of the healthcare system. Such networks are of high relevance because they are able to shape and stabilize fragmentation in care delivery and they are also able to facility change.[17] Additionally, descriptive network measures are applied to investigate structural change.

Finally, institutional theories are applied that help to understand so called inhabited institutions that connect the action realm with the institutional realm.[18]

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[15] Socially shared practices can be organized as "communities of practice [which] are not self-contained entities. They develop in larger contexts – historical, social, cultural, institutional – with specific resources and constraints" (Wenger 1998: 79). With regard to the theory of path dependence has to be mentioned that practices always are twofold: "The local coherence of a community of practice can be both a strength and a weakness. The indigenous production of practice makes communities of practice the locus of creative achievements and the locus of inbred failures; the locus of resistance to oppression and the locus of the reproduction of its conditions; the cradle of the self but also the potential cage of the soul" (Wenger 1998: 85).

[16] "Network analysis all too often denies in practice the crucial notion that social structure, culture, and human agency presuppose one another, it either neglects or inadequately conceptualizes the crucial dimension of subjective meaning and motivation […]" (Emirbayer/Goodwin 1994: 1412). Therefore actors are seen as "embedded in networks of interconnected social relationships that offer opportunities for and constraints on behavior" (Brass et al. 2004: 795).

[17] One example of informal networks in healthcare provision are informal referral or consultation networks. In such networks the actors are able to control for network membership (rules of attachment) or a specific network culture that can be used to sustain existing structures. This is what Freidson (1979) called an inner brotherhood that is based on a strong professional identity and that gets supported by even strong professional associations on different system levels.

[18] "Recent studies of inhabited institutions have extended micro-sociological perspectives on work and occupations to enhance theorizing within organizational institutionalism. Organizational institutionalists consider the relationship between organizations and their institutional context, with a particular eye to the cultural pressures that induce structural conformity" (Bechky 2011: 1158).

Discussion and Conclusion

Finally, I would like to come back to the two questions I stated above. So, where could path dependence be located? In my study, path dependence unfolds in regulation practices and therefore in-between the actors in the field of ambulatory health care. That means the elementary unit of analysis would be a dyad of actors. Because healthcare provision is a complex task which is undertaken by more than two actors, the investigation of path dependence asks for a network level perspective.[19] But when path-dependent practices are produced by the interplay of several actors on different system levels, the occurrence of path dependence becomes a question of diffusion. And when path dependence occurs as a certain logic that is shared and that coordinates inter-actor regulation, the locus of path dependence somehow alternates.[20] That means in complex systems path dependence cannot be ascribed to a single actor or to a single system level. Instead, it has to be regarded as circularly produced and recursively embedded.

The second question asks for what drives the path-building process in complex systems. Recent studies are stressing the importance of agency and do argue for a constructivistic turn in path theoretical thinking.[21] That means the actors themselves have become important agents of path-formation and change. But "change and stability are both rooted in the interaction order, which draws on, maintains, and confronts social structures" (Bechky 2011: 1162). So, the process drivers are considered on both sides, in the action realm and in the institutional realm.

Such a modeling also asks for reconsidering the relationship between causes and consequences[22]. From my point of view, it could be helpful to overcome dichotomous thinking by developing "softer" models of path dependence. Thus, multilevel and multi-actor approaches could be better able to capture path dependence in the multilayered social world if they can "bear" tentativeness.

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[19] Provan et al. (2007: 480) are stressing the importance of a whole network approach because "[o]nly by examining the whole network can we understand such issues as how networks evolve, how they are governed, and, ultimately, how collective outcomes might be generated".

[20] First of all, coordination effects have formed inter-actor regulation in ambulatory health care. There, the medical profession has been very influential by implementing what I call a "mono-professional logic of care provision". Over time, little by little and step by step, this certain logic (among others) has shaped the regulation practices in ambulatory healthcare provision.

[21] For example the social and cognitive processes in the diffusion of new technologies (cf. Garud/Karnøe 2001: 3) or the recursive and adaptive practices in strategy development (Jarzobkowski 2004).

[22] For Martin & Sunley (2006: 404) one of the "unresolved issues associated with path dependence" is the problem of causality when they ask for solutions to separate causes from consequences. Although a lock-in is regarded as the emergence of stability caused by certain foregoing events, the authors also argue that "processes of path destruction and new path creation are always latent in the process of path dependence" (ibid. 408). So, the remaining question is how to separate, empirically and theoretically, the different phases in the process.

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