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Path dependence in organizations

An explanation based on interdependence between agentic processes

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Introduction: Are Lock-in's Forever?

The theory of path dependence, originally developed to explain the possibilities for market failures (David, 1985, Arthur, 1989), plays an increasingly important role in explanations of 'puzzling persistencies' in organizations. It aims at understanding a specific type of stability for which history matters (Sydow, Schreyögg, & Koch, 2009, Vergne & Durand, 2011, Koch, 2011, Schreyögg, Sydow, & Holtmann, 2011). The explanandum of this theory is organizational lock-in understood as "[…] a rigidified, potentially inefficient action pattern built up by the unintended consequences of former decisions and positive feedback processes" (Sydow et al., 2009: 696).

Path dependence theory however, is far from being uncontested. Some scholars very much doubt the empirical relevance of path dependence in general (e.g. Liebowitz & Margolis, 2013). Most scholarly conflicts however arise around its "susceptibility to fundamental change" (Beyer, 2010: 6). While generally accepting the relevance of historical explanations for present stabilities much criticism evolves around the seemingly inevitable rigidity which supposedly lies at the heart of the phenomenon. The problems of path dependence theory to accept, let alone explain anything that might come after lock-in seems to be specifically troubling in the organizational realm. Here, power and agency seem to defy the possibility of long-lasting, counterfactual rigidity (Garud, Kumaraswamy, & Karnøe, 2010).

Nevertheless, a quick scan of existing literature on organizational change unveils numerous publications concerned with phenomena that show striking similarities with the idea of path dependence (e.g. Burgelman, 2002, Danneels, 2010, Hall, 1984, Leonard-Barton, 1992, Lucas & Goh, 2009, Miller, 1993, Tripsas & Gavetti, 2000). While this supports the general assumption of the existence of organizational path dependence, we also find convincing evidence (e.g. Burgelman, 1994, Plowman, Baker, Beck, Kulkarni, Solansky, & Travis, 2007) for something which cannot be explained without contradicting central assumptions underlying existing theoretical accounts of organizational lock-in: the breaking of organizational paths.

Consequently, it will be the main purpose of this paper to reformulate the theory of organizational path dependence in a way that, while explaining the historically conditioned persistencies at the heart of path dependence, does not logically defy the possibility of breaking organizational paths. Instead, the goal will be to (re-)formulate this theory in a way that makes possible the logical inference of strategies to break organizational paths from a more precise understanding of how they emerged in the first place.

Defining the problem: Shortcomings of existing theory

This chapter will be concerned with a critique of existing figures of explanation used in theorizing about path dependence. As there are at least as many different definitions of this phenomenon as there are theories explaining it, it would be a rather exhausting endeavor to try to explicitly account for each theory and/or each definition of path dependence separately. Therefore, I will confine myself to a more coarse-grained version of critique. Contrasting a 'lowest-common-denominator-definition' of path dependence with four major figures of explanation used in contemporary theorizing about the phenomenon I aim at developing a general understanding for the major challenges in explaining path dependence in organizations.

For those who do not question its significance and/or existence (unlike e.g. Liebowitz & Margolis, 1990, Liebowitz & Margolis, 1995, Liebowitz & Margolis, 2013) three features of path dependence seem to be largely undisputed. First, *path dependence is a phenomenon to be found on various levels of the social realm*, including individuals (Frank, 2007), organizations (Koch, 2011, Schreyögg et al., 2011), processes of technology adoption (Arthur, 1994) and institutions (North, 1990, Pierson, 2000). Second, *path dependence is a process phenomenon*. On its most basic level it can be described as a progression of events for which *history matters* (David, 1985, Guinnane, Sundstrom, & Whatley, 2004). Third, path dependence in one way or another is concerned with "*puzzling persistencies*" (Sydow et al., 2009: 695; my italics) *resulting from some form of self-reinforcement* (David, 2007, Dobusch & Schüßler, 2013). In the end it is these persistencies that make the endeavor of developing a proper theory for path dependence relevant for researchers and practitioners alike.

Summing up, most scholars would not question the statement that *path dependence is a social process phenomenon characterized by historically conditioned persistencies through self-reinforcement*. From this lowest-common-denominator-definition of path dependence I will now proceed by asking the question in how far existing figures of explanation are able to cope with the specificities of such phenomena. I identified four major figures of explanation used in contemporary theorizing about path dependence. I labeled them (1) *narrative sequence* (2) *causal sequence* (3) *mathematical formalization* and (4) *agentic process*. While being conceptually distinct, they are often used in combination. By analyzing the strengths and weaknesses of each I will elaborate on the major challenges related to theorizing about path dependence in organizations.

Narrative Sequence

Most of the challenges in describing and explaining path dependence are related to the fact that it is a process phenomenon with many different guises. The properties which describe path dependent processes like non-predictability and inflexibility (Arthur, 1989) may even stand in direct contradiction to each other. The general problem is one of developing a (logically) frictionless description of a whole with contradictory properties. The seemingly obvious solution to this problem is to arrange these properties into a (narrative) sequence: „[T]he properties […] do not actually apply to the whole process of becoming locked into a path. Rather, they appear to cover specific episodes in this process" (Sydow et al., 2009: 691).

This figure of explanation is used in historical narratives, like the now famous story of the QWERTY-standard (David, 1985), or in more formal approaches like in the concept of reactive sequences introduced by Mahoney (2000). It can also be found in phase-models of path dependence (e.g. Sydow et al., 2009). With this figure of explanation the unity of the process is dissolved into different elements (phases/events) which are constructed as (now harmoniously describable) wholes themselves. These elements are then arranged into a narrative sequence solving the problem of developing a logically frictionless description of a whole with contradictory properties.

While this problem is solved, the description of the transition from one element to the next – which in fact would be needed for an *explanation* of the process – is often very fuzzy, if given at all. This is highly critical because most of the explanatory value of this mode of argumentation lies exactly within these "turning points" (Abbott, 1997). Because of the higher degree of formalization of phase models this can be demonstrated using the Berlin Model (Sydow et al., 2009). The highly important but largely unanswered questions regarding this model are: What differentiates the formation phase from that which came before (start of phase I)? How do you identify an event as critical (end of phase I)? When exactly can you speak of a lock-in and what happens to the self-reinforcing mechanisms after lock-in has occurred (end of phase II)? What happens after the lock-in? Does it stop at some point and if yes, how can you think of this (end of phase III)?

The fuzziness this figure of explanation comes with is rooted in the divergent logics of constructing a (historical) narrative about a phenomenon and the actual unfolding of the phenomenon over time: „[T]he narrative is deceitful. For we build our narratives – at least our historical narratives – from back to front. We start with what we know emerged and then seek its origins. But history is lived front to back" (Abbott, 2001: 267–268). As a result even the best narratives will only provide us with a sequential description of the "output-structure" (Hernes, 1976) leaving the underlying procedural logic unexplained. While this can be an important contribution to the understanding of path

dependence, it also introduces some pitfalls. Because narratives are in their form very much defined by the problem they end with, they have the inherent tendency of producing somewhat 'flattened' narratives (Abbott, 1992). For the theory of organizational path dependence this points to the importance of the time-scales used for theory building (Zaheer, Albert, & Zaheer, 1999). The question becomes if the narratives about path dependence would change when one does not take the lock-in but some point before or after that as the problem to start (and end) with. The challenge is to develop a theory of organizational path dependence that is not based on assumptions which logically contradict the possibility to break a path. Again this highlights the importance of understanding the underlying procedural logic of path dependence.

Together, this points us to the first major challenge related to theorizing about path dependence in organizations: the *necessity of a forward-looking theory including an underlying procedural logic which is not contradictory to the possibility of breaking an organizational path*. In the Berlin Model this problem is partly dealt with by the (mostly) implicit assumption that there is a causal connection between the phases (e.g. self-reinforcement in phase II will cause lock-in in phase III). That this mode of argumentation also has its pitfalls will be discussed next.

Causal Sequence

The causal sequence also implies a sequential order, but, unlike the narrative sequence, explicitly identifies a generalizable cause-effect sequence. The work of Philippe Vergne and Rodolphe Durand provides a good example: „In contrast with past organizational research, we offer a narrow definition of path dependence as a property of a stochastic process which obtains under two conditions (contingency and self-reinforcement) and causes lock-in in the absence of exogenous shock" (Vergne & Durand, 2010: 737). Authors using this figure of explanation mostly do this in order to provide some forward-looking explanation. It also aims at solving one of the biggest challenges in path dependence research: Providing clear definitions of theoretical concepts which can be used to guide empirical research (Dobusch & Kapeller, 2013, Vergne & Durand, 2010, Vergne, 2013).

Authors using this figure of explanation (e.g. Sydow et al., 2009) have definitely contributed to focus our attention on some of the most important aspects of path dependence: contingency, self-reinforcement and lock-in. At the same time, the idea of path dependence as a causal sequence introduces, at least implicitly, a (temporal) differentiation between cause and effect where cause (contingency and self-reinforcement) precedes effect (lock-in). This separation makes it logically impossible to introduce possibilities for breaking the path into the theory because the causes of the

lock-in are situated in the system's past and therefore unchangeable. Contrasting this, empirical research (e.g. Burgelman, 1994, Gilbert, 2006, Plowman et al., 2007) as well as theoretical arguments (e.g. Bassanini & Dosi, 2001, Beyer, 2010) suggest that path breaking has to be considered as a part of the phenomenon and therefore should be explained by the same theory. Additionally, the temporal separation of cause and effect is not in line with a true process view on path dependence. Processes consist of events in which cause and effect are collapsed (Luhmann, 1995). Events emerge from the process they constitute. The concept of emergence, understood as the unity of cause and effect, points to non-deducible properties of processes which are maintained by ongoing processing (cause) while *at the same time* influencing the process' further progression (effect; Goldstein, 1999).

Together this points us to the second major challenge related to theorizing about path dependence in organizations: *the necessity of an emergency-based explanation of lock-in*. Only by conceptualizing lock-in as an emergent result of a specific way of processing can we hope to find *a present cause for the ongoing persistence of this phase*. This would be the first major step towards the inclusion of a logical possibility for path-breaking (except exogenous shocks) into a theory of path dependence.

Mathematical Formalization

Due to its origins in economics a lot of publications about path dependence use mathematical formalizations as the *basis* for their theorizing (e.g. Arthur, 1983, Arthur, 1989, Arthur, 1994, Arrow, 2004, David, 2007, Jackson & Kollman, 2012, Kay, 2013, Page, 2006, Vergne & Durand, 2010). The big advantage of this approach is that it enables precise definitions of the phenomenon. Such a definition is for example given by Paul David: "a path dependent stochastic system is one possessing an asymptotic distribution that evolves as a consequence (function) of the process's own history" (David, 2007: 98). Using the language of mathematics this function – which lies at the heart of the phenomenon – can also be described in very precise terms. In fact a number of different formal processes like homogenous Markov-chains, branching processes or the generalized Polya process can exhibit the critical feature of "[…] limiting outcomes being contingent upon improbable transitions that occur at some historically remote moment on the developmental path" (David, 2007: 99).

Unfortunately, this increased preciseness in definition also seems to bias the scientific discourse. The possible level of logical preciseness reachable with mathematical definitions seems to motivate some scholars to develop ever more precise definitions. The long-term consequence is the increasing marginalization of path dependence as a social phenomenon. Arthur's first publication on this topic provided some quite straightforward formal characterizations of a phenomenon which were widely

applicable: typewriter keyboard designs, programming languages, transportation standards, televisions systems, and all showed signs of path dependence (Arthur, 1983). After almost 20 years of increasingly specific mathematical-formal definitions we have arrived at a point where "[t]he requirements […] are quite demanding conditions and suggest to us that equilibrium dependence, meaning path dependence, is a rare phenomena" (Jackson & Kollman, 2012: 162).

The proponents of this 'war on definitions' argue that it is exactly this preciseness which is necessary for path dependence to 1) be proven and as a result 2) be relevant (see e.g. Kay, 2013, Liebowitz & Margolis, 2013, Vergne & Durand, 2010). While this is a reasonable endeavor it is often overlooked that the preciseness of a *mathematical-formal* explanation of a *social* phenomenon is only useful in so far as it is possible to transfer the level of preciseness reached in the mathematical realm into an equally precise account of the social realm. Unfortunately, most scholars tend to loose much of their preciseness during this highly critical translation process. Vergne and Durand (2010) for example explain at length the complicated issue of how to prove contingency, a critical part of their formal definition of path dependence. In the end they come to the quite unsettling conclusion that "[…] the verifiability of contingency, a necessary condition for path dependence, remains a serious issue" (Vergne & Durand, 2010: 746). In the same paper the authors elaborate specifically on path dependence in organizations. But there, confronted with the challenges of describing the social realm, instances of "unexpected encounters" or "trial-and-errors leading to unattended consequences" seem to be sufficient to argue that the "existence of contingency in organizational life is a reasonable assumption" (Vergne & Durand, 2010: 741). This gap between words and deeds tend to become greater the more scholars start their theorizing with problems of the mathematical rather than the social realm (see also Jackson & Kollman, 2012, Walker, 2010).

Because of all the difficulties related to transferring mathematical precision into equally precise accounts of to the social world without loosing track of the phenomenon itself, I would argue that – specifically for organizational path dependence – it is unwise to use mathematical formalization as the sole (or primary) basis for ones theorizing. This points us to the next major challenge in developing a proper theory of path dependence in organizations: the necessity (or better: the advantageousness) of *using empirically observable and relevant concepts as <u>the basis</u> for theory building*. When one starts theory building using concepts which are observable and relevant in the organizational realm the dangers of ending up with a theory that is neither relevant nor testable in the field are significantly reduced.

Agentic process

In an effort to solve problems related to the "susceptibility of path dependence to fundamental change" (Beyer, 2010: 6) some scholars have developed conceptualizations of path dependent processes which differ fundamentally from classical accounts (e.g. Garud & Karnøe, 2001, Garud et al., 2010, Pentland, Feldman, Becker, & Liu, 2012). The difference is basically twofold: First, these conceptions of path dependence are firmly based in agency theory (Emirbayer & Mische, 1998) taking an "insiders perspective" (Garud & Karnøe, 2001). This provides a possible avenue for solving the above mentioned difficulties regarding the relevance of formal definitions in the social realm. At the same time it does not inhibit formalization and precise definitions (see Pentland et al., 2012for an example). Put differently, it accounts for the problem "[…] that although path dependence focuses on a sequence of specific microlevel events, it does not have an explicated theory of agency" (Martin & Sunley, 2006: 408). The second difference – also related to its bases in agency theory – is the assumption that history – or more generally, time – is a social construct. This provides a conceptual basis for another major challenge in theorizing about path dependence. When the history that matters in an organization is not conceived as a necessarily fixed past event-sequence anymore, but more as an actively constructed time-horizon which is constantly reenacted (Emirbayer & Mische, 1998), then there also exists a logical possibility to change it, i.e. to break the path.

Using agency theory as a basis for conceptualizing path dependence has the potential to solve many problems implicit in the other figures of explanation. Nevertheless, this leads to a new class of problems: Even though it does help in explaining possibilities for change, what it cannot explain is stability. The path creation perspective, originally developed by Garud and Karnøe (2001), provides a good example. They are explicitly referring to the agentic dimension in the construction of time-horizons and its importance for decision making (Garud et al., 2010). As a result they end up with a conception of the process that doesn't seem to account for the possibility that an organization actually can end up in a problematic lock-in. Consequently they ask the question, if "[...] lock-in [would] ever occur at all" (Garud et al., 2010: 766).

This points us to the last major challenge in theorizing about path dependence in organizations: A proper theory of path dependence in organizations has to *account for the fact that social action does not only result from "contingency of action" but also from "contingency of events"* (Ortmann, 2009). In the case of organizational path dependence the passively experienced contingency of events points to the fact that social actors, even though capable of purely agentic acts (contingency of action), also always have to deal with the often troublesome 'realities' of a given situation (contingency of events; Ortmann, 2009). Their actions can be constricted by various contextual

factors. An agency-based theory of path dependence must also be able to account for this kind of "constructed objectivity" (Berger & Luckmann, 1966).

Implications for Theory Building

Despite the difficulties existing agency-based theories of path dependence have with explaining stability there are still good reasons to use this figure of explanation as a starting point. The most important one is related to the fact that path dependence calls for a true process approach (Schreyögg & Sydow, 2011). In the social realm this calls for a conception of agency as this is the primary source of continuous variation in this sphere (Emirbayer & Mische, 1998, Mead, 1938). This in turn can provide a viable basis for a real process theory (Abbott, 2001). When theory-building *starts* with a stability assumption – may it be stability in terms of mechanisms (e.g. Dobusch & Schüßler, 2013), mathematical and/or utility functions (e.g. Arthur, 1989, David, 2007), phases (e.g. Sydow et al., 2009) or simply the assumption of a rigid end-state as the starting point for constructing a narrative (e.g. David, 1985) – it will inevitably end up with rigidity: "[B]y making stasis primary [a theory] looses its ability to explain change. If we would explain change at all, we must begin with it, and hope to explain stasis [...] as a by-product" (Abbott, 2001: 266; for similar arguments see e.g. Mead, 1932, Luhmann, 1995). Therefore, the primary aim of a theoretical account of path dependence in organizations must be to find *an agency-based explanation for historically conditioned stabilization in organizations*.

An agency-based explanation also seems to be an adequate basis for the challenge identified while elaborating on the strengths and weaknesses of the narrative sequence: the formulation of a forward-looking theory which is not contradictory to the possibility of breaking an organizational path. Generally speaking, this is only possible when the theory is formulated in a way that lock-in is not the only outcome the theory explains. Surprisingly this is NOT true for most theoretical accounts of path dependence (for an exception concerning institutional path dependence see Crouch & Farrell, 2004). A close examination shows that most theories of path dependence in fact only explain which path is selected, but do not explain why a process becomes path dependent in the first place. This is true for mechanism-based explanations (e.g. Dobusch & Schüßler, 2013, Sydow et al., 2009) because they generally do not explain but just assume the existence of a (positive feedback) mechanism when they observe path dependence. This is also true for most mathematical-formal accounts of path dependence (e.g. David, 2007, Jackson & Kollman, 2012) where locking into one of the possible paths is the only result these functions can produce. Consequently, such a function cannot provide an explanation for why the process had become path dependent. Again, the only thing that is explained

(by the form of the function plus some chance events) is which path was selected. What is needed is a *theory of path dependence in organizations that does not treat lock-in as the only possible outcome to be explained*.

Concerning lock-in I argued for the necessity of an emergency-based explanation while elaborating on the strengths and weaknesses of explanations based on causal sequences. Emergence "[…] refers to the arising of novel and coherent structures, patterns, and properties during the process of self-organization in complex systems. Emergent phenomena are conceptualized as occurring on the macro level, in contrast to the micro-level components and processes out of which they arise" (Goldstein, 1999: 49). Starting from this definition of emergence we can already infer that a theory concerned with the explanation of emergent results inevitably has to be a multi-level theory differentiating between micro-level components and macro-level outcomes. The importance of a multi-level approach for explaining and investigating path dependence is already widely recognized (e.g. Dobusch & Schüßler, 2013, Sydow, Windeler, Müller-Seitz, & Lange, 2012). A second necessary aspect to explain emergence however has remained largely unaccounted for. For something to emerge it needs „[…] *nonlinear interactivity* [which] leads to novel outcomes that are not sufficiently understood as a sum of their parts" (Goldstein, 1999: 53; own italics). It is this non-linear interactivity which takes the logical place of self-reinforcement in an emergency based explanation of organizational path dependence (see Birnholtz, Cohen, & Hoch, 2007 for a similar argument). *Explaining path dependence as an emergent phenomenon therefore has to differentiate between micro-level components and macro-level outcomes, and needs an understanding for the specific ways the micro-level components interact with each other*.

Finally, in the discussion of the mathematical-formal approach to path dependence, I concluded that – while not logically necessary – it seems wise to use empirically *observable and relevant concepts* as the *basis* for theory building. The primary goal of this paper is to reformulate the theory of path dependence in *organizations*. Therefore, it is necessary to develop a more concrete understanding about what actually does become path dependent in an organization. This will be the goal of the next chapter.

Specifying the Phenomenon: What is (not) locked-in in organizations?

A *genuinely organizational phenomenon* which shows the main features of path dependence is what some researchers have-called the "*paradox of success*" (Audia, Locke, & Smith, 2000). It refers to the

empirical fact that in organizations (and especially in firms) “success can breed failure” (Gino & Pisano, 2011). This genuinely organizational phenomenon is known to have *a historical explanation*. It can be demonstrated empirically that for some organizations past success correlates with present persistence (e.g. Audia et al., 2000, Boeker, 1997, Christensen, 1997, {LGino & Pisano, 2011ant 1992 #554}). Most explanations for this phenomenon are based on one or more of the *positive feedback mechanisms* argued to be the major drivers of organizational path dependence (Dobusch & Schüßler, 2013, Sydow & Schreyögg, 2013). Finally, this phenomenon is known to potentially end up in organizational crisis and decline due to some form of *counterfactual stability on the organizational level* (e.g. Burgelman, 1994, Burgelman, 2002, Danneels, 2010, Hall, 1976, Hall, 1984, Koch, 2008, Koch, 2011, Leonard-Barton, 1992, Lucas & Goh, 2009, Miller, 1990, Miller, 1993, Schreyögg et al., 2011, Tripsas & Gavetti, 2000).

By closely analyzing the available case studies of such organizations we can learn a lot about how the puzzling persistence at the heart of every path dependence theory looks like in organizations. First and foremost it must be stated that organizational lock-in does only look like stability from a very specific point of view. Would we look at cases of organizational lock-in from a different perspective we would see a quite different picture: Opposing coalitions fighting for dominance (Hall, 1984), newcomers trying to convince long-serving managers in countless discussions that what was right during the last decades is now suddenly wrong (Lucas & Goh, 2009, Tripsas & Gavetti, 2000), increasing turn-over rates in top management together with a general sense of crisis (Holtmann, 2008), or professionals fighting hard to preserve their ethos (Koch, 2011). All this dramatic movement during the lock-in phase defies the picture of a rigid organization and calls for a more precise definition of what actually does become persistent in a path dependent organization.

In this respect the available case studies do NOT suggest that persistence can be observed in terms of repetitive organizational actions or repetitive sequences of actions. Locked-in organizations do not always do the same. Rather, what seems to show signs of persistence is a specific *approach* towards accomplishing an ongoing, complex organizational task. May it be the razor-blade business model of Polaroid (Tripsas & Gavetti, 2000) or the ideals of good journalism (Koch, 2011). In the case of path dependence core-competencies seem to turn into core-rigidities (Leonard-Barton, 1992). All this brings us close to the concept of an organizational capability, understood as “a problem-solving architecture composed of a complex set of approved linking or combining rules” (Schreyögg & Kliesch-Eberl, 2007: 915) as the core explanandum of our theory.

Organizational capabilities are a promising conceptual basis for a theory of path dependence in organizations (see also Vergne & Durand, 2010, Vergne & Durand, 2011). Their conceptual

characteristics make possible to formulate a theory which meets the above formulated requirements. Capabilities can be understood as a *macro-level outcome of interacting micro-level components*, routines (Peng, Schroeder, & Shah, 2008, Salvato & Rerup, 2011). The conception of dynamic routines (Feldman & Pentland, 2003) stresses the agentic bases of organizational routines (Feldman, 2000, Howard-Grenville, 2005, Turner & Rindova, 2012), conceiving of them as generative systems (Pentland et al., 2012). Basing our understanding of capabilities on dynamic routines therefore provides us with the possibility to develop an *agency-based explanation of historically conditioned stability*. It also opens up avenues for a path dependence theory that *does not treat lock-in as the only possible outcome* because routines alone will not inevitably end up in rigid end state (Feldman, 2000). Equally, while it is often reported that capabilities develop in a path dependent fashion, their development does not necessarily end up in lock-in (Dosi, Nelson, & Winter, 2000, Schreyögg & Kliesch-Eberl, 2007). The explanatory value of a theory of path dependent organizational capabilities would therefore be to elaborate on the specific dynamics which cause lock-in of organizational capabilities.

In sum, empirical as well as theoretical research is indicative that organizational capabilities lend themselves as the basis for a theory of path dependence in organizations. Consequently, the general process we look for has to be described as the evolution of an organizational capability. And the central question to be answered next is: *How can we conceive of a path dependent evolution of an organizational capability*?

Reformulating the Theory: The path dependent evolution of an organizational capability

In this chapter I will propose to understand path dependence in organizations from the perspective of the evolution of an organizational capability. I conceptualize path dependence as the emergent result of interactions between routines. Path dependence is caused by a combination of three interrelated feedback dynamics: (1) the coordination effect will lead to increases in the number of structural relations between the routines; (2) the resulting increases in structural congruence between the routines will lead to a growth dynamic guided by misfit-complementarities; (3) the resulting increases in profitability will foster a positively biased trend-based aspiration level formation. The ever-increasing aspiration levels will in turn develop some endogenous pressure calling for the active and intentional nurturing of the other two feedback dynamics. The routines are affiliated to each other by a common resource-pool which they all access together. The feedback

dynamics can arise between interdependent dynamic routines under some environmental pressure and given initial successes. They will lead to increasing levels of counterfactual stability of the routine-system. Also, first signs of environmental changes will be systematically overlooked. As a result reactions to disruptive environmental change will be belated and decisions will be taken under a threat-framing further increasing the capability's rigidity. The strong assumption of this theory is that *only* when *all three* feedback dynamics are maintained over a *prolongued* phase of success, will the capability become locked-in. I will formulate my theory as a succession of events that is likely under specific boundary conditions.

Initiation

The evolution of an organizational capability starts with a broad definition of a general, ongoing and complex organizational task by some organizational actor(s). The organizations existing resource pool together with some new knowledge and technology supplied by providers will most likely be the basis from which the organizational capability develops. Very early on in this process some general understanding for this task will start to form. It is these first mental models together with the provided resource pool which will guide processes of labor division. Subtasks will be defined around which routines start to form (Narduzzo, Rocco, & Warglien, 2000).

Aspiration Formation

Initial successes – which while ex-post explainable, will most likely not be predictable ex-ante –have the potential to ignite and give direction to the feedback dynamics at the core of this theory. They have the conceptual function of small events in path dependence theory. Positive experiences in the beginning of such a process are known to introduce a positive bias in aspiration level formation with some stability over time (Perlow, Okhuysen, & Nelson P. Repenning, 2002, Lant, 1992). Also, aspiration levels will be based on past trends (Perlow et al., 2002, Sterman, 1986, Sterman, 1988). In so far as some level of success can be maintained this will result in a constantly high level of endogenous pressure to further increase the efficiency of the capability (Perlow et al., 2002). This in turn will ignite the coordination dynamic discussed next.

Mutual Adaptations

Together with the endogenous pressures introduced by positively biased aspiration level formation some environmental pressure will motivate coordinated adaptations of task interdependent routines. Mutually adapting their structural form to each other (i.e. establishing a structural relation) will increase the effectiveness of accomplishing the general task (Narduzzo et al., 2000). Routine-based coordination implies standardizing behavior with rules in order to make behavior predictable

towards each other (March & Simon, 1958). Actors can know in advance what the other actors will do. The dynamic resulting from benefits of this kind of standardization is often called the coordination effect (North, 1990, Sydow et al., 2009). The resulting increases in efficiency will further stabilize the positively biased processes of aspiration formation.

A structural result of this dynamic of mutual adaptation will be the growth of a system of formal and informal rules (March, Schulz, & Zhou, 2000) which are conductive to the necessary basis of successful coordinating: accountability, predictability and a common understanding of the complex organizational task (Okhuysen & Bechky, 2009).

Another likely result of this dynamic is based on the assumption that while overall routines will be adapting to each other continuously, it is improbable that all routines are adapted at once. Rather, one would assume sequential and incremental adaptations of single routines or small groups of routines (Argote, 1999). Importantly these sequential adaptations will mostly be locally rational, meaning that the immediate context of the routine (or the small group of routines) will strongly influence if a given adaptations 'makes sense' or not (Feldman, 2003, Howard-Grenville, 2005). In the case of an organizational capability we would expect other routines to be the most important context of this locally rational behavior. Hence the coordination effect will lead to a sequence of alternating locally-rational, mutual adaptations of those routines which together form the capability's basis.

Sequential locally-rational adaptation processes lead to increasing levels of specification together with "[…] improvement in performance as alternatives with good outcomes in previous samples come to dominate future samples" (Denrell & March, 2001: 524). However, they are also known to lead to the so-called "hot-stove effect" which refers to "[…] the asymmetry in the capability of adaptive processes to correct early sampling errors" (Denrell & March, 2001: 524). This implies a learning trajectory *for the capability* which will be heavily influenced by initial conditions, lead to exploitational learning in each routine (due to the hot-stove effect), increases in efficiency for the whole capability (due to the coordination effect) and a bias against new, risky alternatives (due to both). However, it will NOT lead to total rigidity for at least three reasons: First, routines will produce ongoing variation (Feldman & Pentland, 2003). Second, sequential adaptation processes of routines will be imperfect, thereby weakening the hot-stove effect (Denrell & March, 2001). Finally, the whole system of routines does not evolve in a vacuum, but in a (more or less) dynamic environment which will produce new technologies, be a source of new personnel, etc. Put differently, a dynamic environment will – in one way or another – motivate the ongoing replacement of old as well as the

integration of new routines into the existing system. While this adds some dynamism it also provides a basis for the third feedback dynamic which will be discussed next.

Misfit-Complementarities

In so far as the capability is being identified as important for the organizations survival it will attract further resources and power (Hall, 1984; Whetten, 1987). Together with some level of environmental dynamism this will lead to the growth of the routine cluster constituting the capability. New routines will be integrated to the existing cluster. In this regard it is important to note that the dynamics of mutual adaptation described above also imply the emergence of complementarities between routines. Complementarities can be defined as "[…] the beneficial interplay of the elements of a system where the presence of one element increases the value of others" (Ennen & Richter, 2009: 207). Due to the increasing levels of structural congruence between routines of the existing cluster, it will become ever more costly to integrate new routines that do not fit. Therefore, misfit-costs will increasingly guide the acceptance of new routines by the established cluster (North, 1990, David, 1994).

The definition of what misfit means inside this system will emerge as some form of common understanding about what it takes to be successful which is resulting from the dynamics of mutual adaptations described above (Okhuysen & Bechky, 2009). In turn, each new routine added to the cluster also implies a structural change in the context of other routines, keeping alive the dynamic of mutual adaptations described above.

This growth dynamic guided by misfit-complementarities is likely to set up a system of fitting routines which obtains further rewards when the new routines help saving misfit costs (North, 1990, David, 1994, Stieglitz & Heine, 2007). It is important to realize that complementarity in the sense defined here amounts to a self-reinforcing effect, i.e. it becomes ever more attractive to save misfit costs caused by new solutions deviating from the established cluster (Sydow et al., 2009).

Lock-in

Importantly, these three interrelated dynamics are not based on some exogenous law-like mechanism, but result from locally-rational agentic behavior under some boundary conditions (early successes, importance of the capability for the organizations survival, ongoing environmental pressure and dynamism). Together, these three interrelated dynamics between interdependent routines will lead to the emergence of a specific learning trajectory on the capability level. In the beginning of this learning process the organizational capability will be quite open to novelty as the underlying system of routines will be characterized by lower levels of structural congruence and

fewer routines. As the interrelated feedback dynamics result in higher levels of structural congruence among a growing number of routines the system will gradually loose its ability to integrate new knowledge (i.e. new routines). The learning trajectory is the organizational path as an emergent result of interdependent, locally-rational routinization processes. The theory provides the endogenous, historical explanation for the "puzzling persistence" of an organizational capability we were looking for.

The decreasing levels of what might also be described as the cluster's absorptive capacity (Cohen & Levinthal, 1990) will mainly result from two limiting factors: First, even though programmed coordination of routines significantly reduces the necessary information processing capacity on the cluster level (Galbraith, 1974), the information processing demands will still increase continuously until a limit is reached (Stanley et al., 1996). Second, resulting from the increasing costs of adapting the whole cluster to a new routine that doesn't fit, the cluster of complementary routines will gradually lose its ability to integrate new types of routines (David, 1994; Sydow et al., 2009). When the system of interdependent routines approaches these limits we can speak of lock-in. The routines will be highly interconnected and the cluster's absorptive capacity will be very low. Importantly though, even this stage does not imply complete rigidity in terms of the evolution of the capability. Existing routines may be replaced by functional equivalents. New, perfectly fitting routines might still be 'squeezed in'. Also, this lock-in definition does not imply any signs of crisis and/or inefficiency within the organization. What it does provide is an explanation for the stability of an organizational capability's learning trajectory. Crisis and inefficiency only arise when the environment changes and this stability becomes problematic.

Problematic Lock-in

The more precise understanding of what path dependence in organizations looks like also enables us to identify the crucial factors which will lead to the counter-factual reproduction of this persistence (i.e. problematic lock-in) in the presence of a disruptive environmental change.

First and foremost it is important to highlight that a locked-in organizational capability will have all the characteristics of a dynamically-complex system (Diehl & Sterman, 1995, Sterman, 2004): Because of the numerous interdependencies between the routines it is characterized by multiple feedback loops, time delays, and nonlinearities. Such systems exhibit characteristics which defy the (locally-rational) logics of human actors: Cause and effect will be temporally far apart, small causes can have large effects and feedback loops form closed causal networks (Hall, 1984, Diehl & Sterman, 1995, Sterman, 1989). When a disruptive environmental change now calls for the intentional and planned change of such a system most actors will have great difficulties in managing this task

because “[p]eople generally adopt an event-based, ‘open-loop’ view of causality, ignore feedback processes, fail to appreciate time delays between action and response an in the reporting of information, do not understand stocks and flows, and are insensitive to nonlinearities […]” (Diehl & Sterman, 1995).

Additionally, the trend-based formation of aspiration-levels will systematically increase the risk that first signs of a trend reversal are being overlooked (Sterman, 1986, Sterman, 1988). Therefore, efforts to adapt the system of interrelated routines will come only when the crisis is already an undeniable threat. Because the capability will most likely play a central part in the organization this threat will not just be limited to the locked-in capability. Under threat organizations react with the so-called threat-rigidity: “The consequences of threat on the organization can be placed in three groups. First, due to an overload of communication channels, reliance on prior knowledge, and a reduction in communication complexity, there may be a restriction in the information-processing capacity of the organization. Second, due to a centralization of authority and increased formalization of procedures, there may be a constriction in control. Finally, there may be increased efforts to conserve resources within the system through cost-cutting and efforts for greater efficiency” (Staw, Sandelands, & Dutton, 1981: 515–516).

Overall this will result in increased levels of counter-factual stability. The system of interdependent routines has reached the problematic part of the lock-in phase. Importantly though, the problem is NOT some past event-sequence, the problem is intentionally changing a dynamically-complex system of interdependent routines under conditions of threat-rigidity.

Discussion: New Possibilities

The main purpose of this paper was to reformulate the theory of organizational path dependence in a way that makes possible the logically frictionless integration of the possibility to break a path. Looking at existing theoretical accounts of path dependence I identified four important preconditions for this endeavor: First, I argued that a theory of path dependence in organizations calls for *a true process approach*. Consequently, I chose to base my theory on the concept of dynamic routines understood as agency-driven, generative systems. A true process approach trying to explain stability inevitably needs an understanding for emergence. Therefore, the second important precondition I identified was the necessity of an *emergency-based explanation of path dependence understood as a multi-level phenomenon*. Together with the third precondition I identified – the use of observable and relevant concepts for theory building – this led me to choose *organizational capabilities*

understood as the emergent result of a system of routines as my conceptual basis. Finally, I argued that from a conceptual point of view it is important that *lock-in is not the only possible outcome of the theory*. Therefore, I refrained from using mechanism based explanations of path dependence. Instead, the emergence of the path – which is defined as the learning trajectory of an organizational capability – is the result of *interdependencies between locally-rational agentic processes of routinizing*.

Based on the reformulated theory of path dependence in organizations I can now logically infer *several possible outcomes of the described process of capability evolution*. The first and most important one, *lock-in*, has already been described at length in the last chapter. It is worth noting that owing to the boundary conditions environmental pressure and environmental dynamism the *duration to lock-in may vary considerably*. The second possible outcome which is explained by this theory might be called *exogenous path disruption*. When the environment experiences a disruptive change before the capability reaches its limiting conditions (information processing capacity, available resources) the capability will not lock-in. The third possible outcome is *endogenous path management*. The emergence of the path might be accelerated, slowed down or brought to a halt by managing the three interrelated dynamics which emerge from these interdependencies. This can be done by intentionally influencing the internal evaluation standards (aspiration level and mutual adaptations) and the availability of resources for further growth (misfit-complementarities). Importantly though, especially under conditions of competition slowing down or stopping path emergence is probably unlikely because it would also mean to sacrifice the economic and social benefits of 'going with the flow'.

When the capability is already locked-in two possibilities for breaking the path can be inferred from the theory. First, referring back to the logical core of the theory, we can state that it is always easier to create a new path than to break an existing one. Because not the whole organization is locked-in but a specific organizational capability it is logically possible to let a new capability emerge as a functional substitute. This new capability will adapt itself to the new environment through the same dynamics that led to the emergence and success of the old capability. Existing research suggests that such a strategy, which others have named "temporarily divide to conquer" (Siggelkow & Levinthal, 2003), has two important preconditions. First, it is critical to create and protect a new and independent resource pool. Otherwise the dominant coalition which will have formed as a result of the capability's success, will take over. Second, it seems critical that the new capability somehow evolves in a way that makes possible its later reintegration. Otherwise the chances are high that the new capability will be rejected by the (still) dominant coalition (e.g. Tripsas & Gavetti, 2000). How this can be done seems to be a largely unanswered empirical question (but see e.g. Day, 1994 for

important insights). This strategy's advantage is that it does not imply destroying the self-reinforcing dynamics which keep the old capability 'up and running'. This is important because they are not just the origin of lock-in but also critical for the organizations success. Nevertheless, the strategy also has one important downside: Somebody inside the organization with the necessary power and resources to create and protect a substitute capability has to sense and take serious early signs of a disruptive environmental change.

The second – at least logically possible way – to break a path is concerned with the time when lock-in has already become problematic. In this situation there won't be enough time/patience or resources available to first create a substitute capability which can then be reintegrated. Therefore, the existing capability has to be changed with a viable alternative already at hand. It will need a powerful, top-down approach and a lot of resources. Also, there will be a high risk of failure due to increasing levels of threat-rigidity throughout the whole organization. As already outlined above, this strategy, while neither logically nor practically impossible, is prone to failure due to the dynamic complexity of the system.

Conclusion

I am very aware that there are other possibilities to write an explanatory narrative about the emergence of path dependence in organizations which could be used interchangeably. Nevertheless, I would argue that this is not true for general figure of explanation I developed in this paper. Basing the theory of organizational path dependence *on interdependence between agentic processes* solves many problems other figures of explanation commonly used in explaining path dependence have while preserving the explanatory core of the phenomenon: historically conditioned, puzzling persistencies.

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