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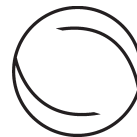
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Once we begin to think in ecological terms, we shall soon learn that every niche or habitat is one of its own kind, and that its demands call for a careful eye to its particular, local, and timely circumstances. The Newtonian view encouraged hierarchy and rigidity, standardization and uniformity: an ecological perspective emphasizes, rather, differentiation and diversity, equity and adaptability.

Stephen Toulmin, *Cosmopolis: The hidden agenda of modernity*

We are observing the birth of a science that is no longer limited to idealized and simplified situations but reflects the complexity of the real world, a science that views us and our creativity as part of a fundamental trend present at all levels of nature.

Ilya Prigogine, *The end of certainty: Time, chaos, and the new laws of nature*

If things seem simple, if your actors seem single-minded, you're not paying attention. Instead, you are settling for the misleading focus induced by hindsight. You need to restore the past to its own present with all its incoherence, complications, and 'might-have-beens'.

Karl Weick, The generative properties of richness, *Academy of Management Journal*

Towards the end of *The social psychology of organizing*, Karl Weick urges practitioners to 'complicate' themselves (Weick 1979: 261). A complex practitioner sees patterns, says Weick, a less complex one misses. This formulation is, in effect, a variation of Ashby's law of requisite variety, which Weick often refers to in his book: only complexity can cope with complexity (Ashby 1956: 206; Beer 1966: 279). But Weick directs his advice not only to practitioners: organization theorists,

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too, need to acknowledge the complexity of their object of study – organization(s) – and reflect that complexity in their theoretical frameworks and research designs (Boisot & McKelvey 2010; Morin 2008; Tsoukas 2005). Indeed, the entire *The social psychology of organizing* may be seen in such terms: how social systems in general, and organizations in particular, may be rethought in terms of processes; how emergence is an irreducible part of organization; how it is more complex to think in terms of verbs than nouns; and how thinking is complexified, developing to wisdom, when it embraces ambivalence and paradox (Weick 1979: ch.9; 2001; 2007). Weick invites us to see organization not merely as a system of authoritative allocation of resources, but also as a self-generating pattern – a system of immanently generated and constantly recreated order. His notion of organizing makes this concept suitable for the analysis of socio-economic phenomena at different levels: from small groups, right up to large-scale processes of socio-economic change.

Weick's plea for 'complication' (to replace 'simplification') has been echoed in other disciplines. Albert Hirschman, some time ago, urged economists to 'complicate some categories of economic discourse' (1984: 89) in order to take into account 'the incredible complexity of human nature which was disregarded by traditional theory for very good reasons, but which must be spoon-fed back into the traditional findings for the sake of greater realism' (Hirschman 1984: 95). Critical properties of human beings, noted Hirschman, such as the ability to form metapreferences, to engage in non-instrumental activities, and engage in other-regarding, benevolent and public-spirited activities, make a huge difference to economic activities, although traditional economic theory has not found a way to satisfactorily include them.

Similar themes are echoed in James March's work. Issues of ambiguity, retrospective rationalization, confused and unstable preferences, negotiated goals, and limited rationality have been consistently highlighted in March's research (March 1988, 1999, 2008). The vocabulary may be different from that of Weick but the outcome is broadly similar: to obtain a more complex understanding of how organizations function. For March, rationality is not only bounded but, also, adaptive, contextual and retrospective. Organizations resemble garbage cans more than neat pyramids. Reason is not omniscient – it is developmental, experiential and embedded in social practices. Ambiguity is part of the human condition; individuals are both observers and participants in the decision-making processes they are part of.

March and Weick have helped shift organization studies from the 'Newtonian style' of abstract formalism, or what philosopher Stephen Toulmin calls 'the decontextualized ideal', according to which the sciences at large, and organization studies in particular, should search for the universal, the general and the timeless (Toulmin 1990: 22–36; Tsoukas 2005: ch.9). The Newtonian style is acontextual and ahistorical: contextual influences upon the phenomenon under study must be turned off so that its intrinsic properties may be supposedly revealed; time is reversible, and prediction is symmetrical with explanation. The Newtonian style seeks to dispense with the contingent experience of empirical diversity to identify, under controlled conditions, universal principles.

The style of thinking that underlies March and Weick's work is different. It resonates with developments in strands of traditional cybernetics and systems thinking, second-order cybernetics and, more recently, chaos and complexity science, auto-poetic systems and post-modern philosophy (Cilliers 1998; Cooper 1987; Holland 1999; Kauffman 2008; Prigogine 1997; Thompson 2007; Varela, Thompson & Rosch 1991; von Foerster 2010). It is a style of thinking that is underlain by what Morin (2005) has called 'generalized complexity', namely an approach to knowledge that views an object of study as a *complexus* – 'what is woven together', in Latin – and, accordingly, seeks to link and contextualize rather than split and isolate. According to Toulmin (1990), post-war intellectual, social and technological developments made it increasingly possible to challenge the reductionism involved in the Newtonian ideal and articulate what he calls the 'ecological style' – a

style of thinking that embraces complexity by reinstating the importance of the particular, the local and the timely. The ecological style acknowledges connectivity, recursive patterns of communication, feedback, non-linearity, emergence, ineffability, becoming (Hayles 1991, 1999).

From an ecological perspective, organizational phenomena are thought to consist not of dissociated collections of parts but of wholes emerging out of the open-ended interactivity of constituent parts, embedded in broader wholes, especially societal institutions, interorganizational fields and technological paradigms. Organization is not only imposed from outside but is also immanently generated from within – self-organization is an irreducible feature of social systems. The patterns we observe are crucially shaped by initial conditions and path-dependent processes. Organizations cannot escape finitude, historicity and circularity: they reproduce the beliefs and institutional practices of the societies in which they are embedded. Interacting with their environments, organizations do not confront independent, meaning-free entities but engage in processes whereby organizations create opportunities for understanding themselves, and, in so doing, they shape their links with other organizations in their own image. Individual as well as organizational action is performative: organizational members are not presented with objective problems but they help bring them forth through the application of the symbols, categories, labels and assumptions contained in the tools they use and the practices they draw upon. Change is not an epiphenomenon, but deeply involved in the generation of stability. Novelty is not an exception but immanent in the carrying out of routine action. Improvisation is not an optional extra but permeates rule-governed behavior. Situatedness is important. Materiality matters. Time and irreversibility are generative of new forms. Unintended consequences cannot be ignored. Chance and contingencies are critical.

Unlike the Newtonian style, the ecological style seeks to embrace complexity rather than reduce it. This means that ecologically informed inquiry is sensitive to process, context and time; it makes links between abstract analysis and lived experience; is aware of the performative (as opposed to merely representational) role of language; accepts chance, feedback loops and human agency as fundamental features of social life; acknowledges the social and bodily embeddedness of cognition; seeks to make connections between hitherto opposed notions, such as structure vs agency, mind vs body, individuality vs sociality, organization vs environment, ideas vs objects, abstraction vs materiality, mind vs body, thinking vs practice, substance vs process, knowable vs unknowable, explicit vs tacit, rationality vs politics, substantive vs symbolic, formal knowledge vs experiential knowledge, system vs lifeworld. Such dualisms are more harmful than helpful (Tsoukas 2005: ch.16), since they reduce the phenomena we study into arrays of abstract properties, thus missing their holistic, performative and processual aspects.

Embracing complexity implies awareness of the need to complexify our language to capture the surprising nature of the phenomena we study. Organizations surprise us because of their dynamically emergent properties, which cannot be exhaustively mapped out. As theorists and practitioners we complexify our language when we are able to generate inequivalent descriptions of the phenomena we study (Casti 1994: 276; Tsoukas & Hatch 2001); we discover complexity by ‘complicating’ our language of description. This is more likely to happen when dualisms are overcome; paradox is accepted; temporality, relationality and embeddedness are acknowledged; and reflexivity is practiced. Weick has provided several examples in his work. Consider the following two, both drawn from high reliability organizations (for more examples, see Weick 2007: 15–16; 1979: 222).

1. Recognizing that the map is not the territory enables practitioners to go beyond institutionalized descriptions of their systems to obtain a dynamically contextual understanding of the problems they handle. Reality is simplified when it is seen as equivalent to its representations. By contrast, it is complexified when, as well as representations, practitioners rely on their personal knowledge, developed from a historically informed, relationally constituted, bodily felt

and situationally-based reading of the situation they are immersed in. Personal knowledge, being subject-dependent, is inherently non-formalizable (Polanyi 1962). Insofar as representational (i.e. formal) and personal knowledge interact, inequivalent descriptions of the systems at hand are generated and complexity of understanding is preserved (Tsoukas 2005: ch.12).

For example, commenting on how high reliability organizations (HROs) achieve consistently high reliability, Weick notes the refusal of employees at HROs to reduce the territory to its map. To put it differently, what is striking in HROs is, among other things, the inequivalent descriptions of a situation employees at HROs generate by mobilizing both formal (representational) and informal (personal) knowledge. Says Weick (in Coutu 2003: 87):

I've also repeatedly found that employees at HROs cultivate a fascination with failure by refusing to take shortcuts or simplify reality. Let's say the workers at a nuclear power plant have to shut down the plant's air supply system in response to some emergency signal. They won't treat the plant blueprints as a reliable guide for the system – which a businessperson might do in the interest of getting the job done quickly. Instead, they will check the whole system for valves, piping, or reroutes that may have been added since the drawings were completed. They know that it's what's missing from the blueprints that could cause the really serious surprises. In other industries as well, successful companies often turn out to be those that refuse to simplify reality – that go behind the blueprints.

2. An anti-dualist ontology helps preserve complexity. For example, seeking to explain the high reliability of an aircraft carrier, Weick and Roberts (1993) use the concept of 'collective mind'. The latter is not seen as a set of given properties but as a style manifested in action. Weick and Roberts (1993) argue that individual contributions and the collective mind they enact are mutually constituted rather than separate, with the latter merely being an aggregation of the former. An individual contribution helps enact the collective mind to the extent to which it is closely interrelated with the imagined contributions of other participants in a situation of co-ordinated action. The collective mind is an emergent joint accomplishment, irreducible to any particular individuals; it is made possible to the extent contributing individuals are not seen as atomistic entities but as relationally constituted agents. The collective is always already within the individual; the individual always-already helps reconstitute the collective. Unlike other scholars who have opted for a dualist ontology (think, for example, of the often used juxtaposition between 'tacit' and 'explicit knowledge', 'stability' and 'change', 'values' and 'practices', 'routine' and 'novelty', 'social' and 'technical' – cf. Tsoukas 2005: ch.16; Turner 1995), Weick, as well as Chia (1994, 1999), Feldman (2000), Orlikowski (2007) and Tsoukas and Chia (2002), to mention a few, have sought to find ways through which the terms of each pair are mutually constituted.

Complexity is generated in practice when multiple agents interact in open-ended ways. Complexity is captured in thought when we prioritize relationality – namely that 'nothing is without being in relation' (Dillon 2000: 4), accept that time is no mere medium in which social life unfolds but it rather makes a difference to its very unfolding, unpack events to look into the processes that have led to their formation, and conceive of agents and practices as contingent assemblages in the making rather than as performed entities (Dillon 2000: 9). In other words, we come close to grasping complexity when our language enables us to make distinctions that allow for radical relationality, constitutive temporality, indispensable situatedness and interpretive open-endedness. Such a language helps generate inequivalent descriptions of a phenomenon at hand (such as, for example, Allison's (1971) models of analyzing the Cuban Missile Crisis – see Boisot &

McKelvey 2010: 428–9), including formally modeling a phenomenon in a way that enables us to distinguish between unpredictable path and predictable pattern (Dooley & Van de Ven 1999), seeing multiple orders and assemblages (and how they are generated), and ‘track[ing] the dynamics by which certain tiny events get amplified into extreme outcomes’ (Boisot & McKelvey 2010: 426). The complex is always potentially surprising – in deed and in thought.

Complexity thinking is, appropriately, manifested in different ways in the papers in this Special Issue. The first three papers espouse ‘generalized complexity’ (Morin 2005: 10) as an onto-epistemological template to research organizational phenomena, while the fourth paper adopts a more technical (‘restricted’, according to Morin 2005: 25) notion of complexity as a way of modeling dynamic systems. Whereas ‘generalized complexity’ onto-epistemologically considers all systems as complex, ‘restricted complexity’ stipulates certain criteria for recognizing complexity and defines particular mathematical techniques for studying it. Complexity in the former sense is an attitude; its key metaphor is interweaving. Complexity in the latter sense is a technique; its key metaphor is interaction.

More specifically, Garud, Gehman and Kumaraswamy (2011) show how innovation at 3M is generated through the interweaving of actors, artifacts and practices over time, allowing for nonlinear innovation to occur. As they note, 3M designed its organization to allow for unexpected innovation; it recognized the critical role of luck and made space for it to (unexpectedly) occur. Taking time seriously, the authors show how constitutive temporality operates: how opportunities and favorable moments are endogenized in organizational life through the existence of several organizational arrangements that simultaneously activate different agentic orientations. The anti-dualist ontology is evident throughout the paper: *chronos* is connected with *kairos*, improvisation with design, serendipity with intentionality, and personal initiative with collective memory and business policy.

Lorino, Tricard and Clot (2011) take a non-representational view of organizational complexity. Representational approaches, they argue, focus on ‘syntactic’ complexity, whereas organizing processes mainly raise questions of ‘semantic’ and ‘pragmatic’ complexity. Echoing Weick’s advice to researchers to ‘complicate’ themselves, and Tsoukas and Hatch’s (2001) calls for ‘second-order complexity’, Lorino et al. suggest looking into the complexity of the inquiry process through which researchers explore organizational phenomena. Since complexity is seen as a characteristic of the interpretive relationship between inquirers and situations, what we need, argue the authors, are methodologies that overcome established dualisms, such as representations vs intuition, theorizing vs experimenting and narrative thought vs logical reason. They suggest dialogical mediated inquiry (DMI) as a way of complicating the inquiry process through dialogically generating multiple perspectives in pluralist communities of inquirers. The building blocks of DMI are semiotic mediation (linking situated experience and generic categorizations), inquiry (interweaving logical thinking, narrative thinking and experimentation) and dialogism (the interaction of multiple voices and genres).

Ashby’s (1956: 206) famous dictum that only variety can destroy variety, or, put in terms of the complexity vocabulary, ‘only complexity can cope with complexity’, has often been commented upon, but rarely has a political perspective applied to it. This is what Child and Rodrigues (2011) do in their paper. Criticizing mainstream approaches for implicit environmental determinism, the authors focus on how organizations shape their environments, especially how organizations cope with the cognitive and relational complexity of their environments. Looking primarily into firms diversifying internationally into new and unfamiliar environments, Child and Rodrigues adopt a political action perspective and explore how power is organizationally used to cope with environmental complexity. Depending on the balance of power, organizations have a number of political options available when engaging with complex environments: complexity may be reduced, penetrated or mediated. Linking complexity to power, a political action perspective shows that coping with complexity is not a merely cognitive but profoundly political issue too.

Last but not least, Farjoun and Levin (2011) use concepts and techniques from fractal mathematics to explore the phenomenon of industry dynamism. Fractals are non-Euclidean, nonlinear geometric patterns that can be found as traces of complexity in physical and social systems. The presence of fractal patterns indicates an underlying complex system that can generate complexity endogenously. Farjoun and Levin pose fractals as a contrast to traditional Gaussian-based thinking for the purpose of modeling the uncertainty that stems from industry dynamism. Whereas traditional measures of industry dynamism (e.g., standard deviation) assume that uncertainty arises from a random series of exogenous shocks, a fractal dynamic posits that uncertainty can also arise simply from the deterministic interactions stemming from normal routines and structures. They examine a highly volatile industry, network television, and demonstrate that statistical methods based on fractal mathematics can provide additional, important insight when empirically examining industry dynamism. Further, their results support the notion that much uncertainty and complexity within an industry can arise from the stable systems within the industry itself.

Complexity is the interweaving of things, the irreducible interconnectedness and interdependence that underlies life; it is what practitioners and researchers need to learn to cope with. To paraphrase Weick (2007: 14), complexity may be bewildering but it need not be paralyzing; it has power but we are not powerless to evoke it. This Special Issue is a gentle probe to coax complexity into view; a small step towards enacting the ecological ideal.

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