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The design of emergence in organizations

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Far from being an oxymoron, we propose that the design of emergence is a central process in organization design.

The formal structure of an organization is *designed* by those with the formal authority to do so and refers to the desired pattern of behavior and interactions among agents. However, incomplete specification and imperfect enforcement of designs implies that the realized organizational structure can diverge significantly from the specified formal structure. These divergent elements of the realized structure constitute the informal structure. These are the *emergent* patterns of individual behavior and interactions between individuals, as well as the norms, values, and beliefs that underlie such behaviors and interactions (Roethlisberger and Dickson 1939; Smith-Doerr and Powell 2005).

Given the inevitable divergence between the formal and informal structure, some scholars have argued that an emphasis on the formal structure may be misleading (Granovetter 1985: 487). Others have suggested that the formal structure may be indicative of symbolic value—useful for invoking legitimacy, signaling an ideology, or itself the result of the pressures of conformity—but may be decoupled from the reality of how the organization works (Meyer and Rowan 1977; DiMaggio and Powell 1983). As McEvily et al. (2014) noted, research on intra-organizational social networks often portrays the positions of agents within a social structure without a consideration of how the formal design may have shaped these (pg 312).

Current research is however shaping a different consensus—one which challenges the relegation of the formal structure to a purely symbolic role, as well as the conflation of the realized structure entirely with informal structure (Clement and Puranam, 2017). The informal structure is the portion of the realized structure that diverges from the formal structure but it is not independent of it. Puranam (2018, Chapter 7) offers an analogy from statistics—"Informal structure can be seen as a "correlated error term" in the regression of realized on formal structure. Put differently, the data generation process is one where realized structure is the result of the formal structure and the informal structure (which is itself partly a function of the formal structure)." As Blau and Scott (1962) recognized, "The roots of these informal systems are embedded in the formal organization itself and nurtured by the very formality of its arrangements."

This places at center stage the question how choices about the formal structure shape (and are in turn shaped) by the emergence of the informal structure—i.e., how design and emergence can be linked. There is much complexity to understand here as evidenced

by the research that has examined both mandated and realized patterns of interactions in organizations to date. There are variations in the extent to which the formal and informal structure converge or diverge, as well as in the apparent performance consequences of this (Sosa et al. 2004; Sosa 2008; Gokpinar et al. 2010; Soda and Zaheer 2012; Hasan and Koning 2020).

Mechanisms that link design to emergence in organizations

An overview of the literature suggests that the behavior of individuals in organizations is broadly shaped through design by three sorts of levers (Puranam 2018, Chapter 3).

First, there is the specification of formal structure which in particular takes the form of role delineation—expectations and constraints on action. How roles are defined in relation to each other (e.g., peer-to-peer, reporting, liaison, grouping into units) as well as the division of labor implicit in them captures the mandated pattern of interactions in the most direct way.

Second, there are the parameters that shape the process of sensemaking as the members of an organization learn—through their interactions with their shared task environment (learning by doing) and each other (vicarious learning)—how to make sense of the organizational reality they inhabit. Therefore, the design of the task environment (including feedback mechanisms) and access to connections to others can shape the belief formation which is at the heart of this sensemaking process (Kocak and Puranam 2018). One may think of these as a part of structure, but the mechanisms that affect behavior by shaping learning are subtler than explicit constraints on action, which formal structure is largely associated with.

Third, there is sorting and selection—decisions on who enters (and stays). An important but under-appreciated aspect of organization design, selection processes play a crucial role in shaping the efficacy of the other two levers (structure and sensemaking) of organization design choices. After all, people are not randomly assigned to organizations, so understanding the impact of design choices on organizational performance must take this sorting process—both employer and employee led—into account.

In addition to directly specifying behavior, these levers also shape the emergence of an informal organization, indirectly. For instance, formal structure shapes emergent networks of interaction as well as individual behavior (Mintzberg 1979; Gulati and Puranam 2009). New ties require opportunities for interaction, and the formal structure provides that (Clement and Puranam , 2017). If we think of organizational culture as shared beliefs acquired through learning (Schein 1985), formal grouping provides the focus for the crystallization of sub-cultures. Members of a functional unit (e.g., accounting) may be socialized into an informal subculture with its own values (e.g., conservatism), beliefs (e.g., about the relative effectiveness of accounting standards) and norms (e.g., assisting colleagues with problems). The emergence of networks and norms also depends on the composition of the group, which is controlled through designed selection.

Design therefore shapes individual and social learning in organizations—the core processes that underlie emergence—but do not perfectly determine them. In large part this is because designers necessarily operate with less-than-perfect information, with design instruments that are less than perfectly enforced. Designers, after all, are boundedly rational too. The non-deterministic influence that the formal structure

may have on the informal structure may also take time to unfold. For instance in the case of re-organizations (Nickerson and Zenger 2002; Gulati and Puranam 2009), the formal organization can be changed rapidly, but the informal organization may be subject to limits and lags in its adjustment to the new formal organization (Lamont et al. 1994; Nickerson and Zenger 2002; Paruchuri et al. 2006). Culture (defined by a set of values, norms, and beliefs) changes through exposure to new organizational members and organizational tasks, but not instantaneously (Becker and Geer 1960; March 1991).

The imagery that seems to best capture these probabilistic links between design and emergence is that of the campus architect who lays out the paths and gardens to shape pedestrian traffic. "They lay their cement, install fences and other obstacles, but inevitably the flows of people and classes carve bare spots in the grass where the sidewalks need to be" (Salancik 1995: 347). The architect must come to terms with the facts that some will be more susceptible to their design influences than others, and none may order their behavior on campus entirely in accordance with the architect's desires. But this does not make the architect redundant. Nor do we eschew the use of thermostats to control room temperature, though we know many other factors are important too.

In more prosaic terms, design sets up the rules of the game; but how agents react to and interpret these rules and respond to them, shape the emergent patterns of actual behavior. This is no more mysterious than the fact that every game of cricket played is different though all such games follow the same set of rules. At the same time, it is clear that enhancing our understanding of how changes to the rules can usefully affect the play is valuable. Whatever their relative importance in shaping organizational performance, it is *only* the formal structure—by definition—that is directly amenable to managerial influence—so that knowing how to design emergence is a worthy objective.

With this background in mind, we turn next to a consideration of how the papers in this Special Collection help us deepen our understanding of the links between design and emergence.

Anjos and Reagans (2020) present an agent-based simulation model to examine the emergence of informal structure and its effect on performance in the context of project-based organizations. Managers choose to invest in projects based on information obtained from employee networks, and employee flock to attractive projects, where their co-presence creates network ties. There is thus an exploration–exploitation tradeoff for managers in terms of investing to build networks that produce information vs. investing in projects based on current information. The formal structure in this model is reflected in the delineation of roles (manager and workers) and tasks, as well as managerial resource allocations. The authors shows how goal-seeking behavior of agents and the nature of relationships among workers, which are considered fragile if they decay quickly when they do not work together and are considered robust if they decay slowly, shape patterns of interactions (among workers and between manager and workers). This article further illustrates the possible performance consequences of these emergent informal structures. It thus presents an intricate illustration of how design choices shape emergent patterns of interactions and social structure as well as the reverse (see also

Nickerson and Zenger 2002; Gulati and Puranam 2009; Clement and Puranam 2017 for related models).

Laboratory experiments are in some ways close kin to models: small numbers of actors (agents) are embedded in a theoretically inspired and designed structure to observe their emergent behaviors. Their relevance for understanding the complexity of organizations is no longer in doubt (Zelditch 1969; Falk and Heckman 2009). Kocak and Warglien (2020) take this approach to understand how design in the form of role differentiation, subjects' social history, and transparency of communication shapes the emergence of communication codes through sensemaking (learning). Codes are (shared) associations between labels and stimuli that allow actors to convey meaning and coordinate actions (Arrow 1974). The authors find that transparent communication facilitates shared code emergence. In an important sense, this may be the gift of the COVID19 pandemic for organizations—remote collaboration technologies like Slack and MS teams enable this form of transparent communication, and these may well be useful to continue with even after the pandemic subsides. The authors also find that the effects of role differentiation depend on the subject's social history—illustrating neatly the interaction between sorting and structure/sensemaking that is crucial to understanding the design of emergence. The experimental paradigm developed by the authors will be of broader interest to organizational scientists interested in understanding the emergent processes that underlie coordination, culture and communication in organizations.

Hunter et al. (2020) examine the effect of designed form structure on the emergent informal organization using a quantitative empirical study. This article focuses on the effect of a specific formal design aspect—command chain distance—the length along the chain of command of a path connecting a pair of organizational actors—on the emergence of informal structure in the organization. These authors found that the likelihood of an informal relationship between two actors declines with an increase in the chain of command distance between them, and that the path length between any two actors declines considerably only when both formal and informal ties are considered together. These path lengths and likelihood of informal relationships between actors could have considerable effects on the culture, learning, and performance of the organization.

Tharchen et al. (2020) provide a contextually embedded, qualitative account of the role of design in shaping emergence through sensemaking—but with the unusual twist that the concept of design itself acts as a boundary object. While management scholars hold a generally accepted meaning of 'design', this article takes a qualitative approach to identify what 'design' means for members of different communities. While they found that the interpretation of 'design' differs considerably across different disciplines in terms of vocabularies, practices, and orders of worth, they also found that it enabled interactions among actors of different disciplines. The understanding that their own notion was incomplete, and the corresponding reflexivity was a key factor in fostering these interactions among actors of different disciplines, which might otherwise have been beset with pragmatic and coordination-related constraints on effective communication.

Conclusion

The articles in this special collection will be useful to both researchers and practitioners in organization design. Together, they illustrate the intricacies of the linkages between design and emergence and do so using a variety of methodologies—modeling, experiments, network analysis, qualitative research. We will need this diversity and perhaps more to tackle what is an intrinsically complex topic. Yet it seems clear that as a community, organizational design researchers and practitioners must tackle this challenge if we are convinced of the centrality of the design of emergence to our field.

Besides the general and abstract formulation of the problem, we also wish to highlight a few open questions, partly triggered by what is salient in our current context. For instance, what design interventions can create and sustain organizational culture in a world in which remote collaboration and distributed work become a mainstay of organization design, and not just an expedient response to the pandemic? So far we have been working remotely with colleagues who were hired in and socialized through intensive face-to-face interaction. What will culture and collaboration look like in an organization where colleagues are hired and collaborate without a single face-to-face meeting?

How will the revolution in artificial intelligence - particularly in terms of algorithms as tools of organization design as well as perhaps co-members of organizations, affect the design emergence link? For instance, recent studies have noted that the inclusion of artificial agents into networks of human communicators can play a useful role. Shirado and Christakis (2017) have shown through both modeling and experimentation that "bots" can curtail the tendency to overexploit in collaborative search processes. The noise they generate in the system can prevent entrapment to local peaks. Klapper et al (2020) suggest that the inclusion of artificial agents may improve group decision quality. This relies on the simple behavioral premise that even if "bots" are not very good at ingesting and synthesizing information, they are less prone to conformity pressures. They can thus break "conformity cascades" in discussion processes.

Finally, an important issue that is on the top of organizational design agenda today is that of organizational resilience. The ability of organizations to recover from and perhaps even thrive in the face of unexpected disruptions surely depends on links between the design of structure—which by definition cannot anticipate the nature of unanticipated disruptions—and the emergent processes of mutual adaptation it engenders, which may nonetheless be useful for adapting to the disruption. We see rich opportunities for advancements in both research and practice on these and related topics.

Authors' contributions
All authors read and approved the final manuscript

Competing interests
The authors declare that they have no competing interests.

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