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Adaptive organizational resilience: an evolutionary perspective

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In this paper, we introduce a novel way of understanding organizational resilience. We suggest that organizational resilience can be profitably viewed as an evolutionary process in which organizations adapt their configurations in response to changes in two external conditions — disturbance and munificence. Focusing on the contexts of manufacturing and operations management, we begin by explaining the concepts of organizational configuration and resilience. We then present a framework that views resilience-driven configuration change as an evolutionary process of variation, selection, and retention for a population of firms. The final component of this framework is the use of the cladistic method of classification to develop a hypothesis of the branching order of configuration change. We conclude the paper by presenting a typology that shows how different levels of munificence and disturbance combine to produce two types of adaptive resilience (cladogenetic and anagenetic) and one type of non-adaptive resilience (inertia). We also explain how phylograms can be used to indicate the amount of time separating different organizational configurations.

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Introduction

Why do some organizations cope with adverse environmental conditions better than other organizations? What processes lead to the creation and adoption of new ways of working? These are questions of organizational resilience [1•,2,3••], and to help address them we draw on configuration theory [4,5] and evolutionary theory [6–8] to develop a framework and typology for understanding the response aspect of organizational resilience. The framework provides insights into the mechanisms that govern how organizations produce new configurations to better deal with adverse environmental conditions. We assume that among-organization selection and within-organization selection operate jointly. In the former, market and other environmental forces discriminate between organizations on the basis of the products and/or services they sell. In within-organization selection, organizational leaders proactively create and implement new and better ways of working.

Configurations and resilience in operations management

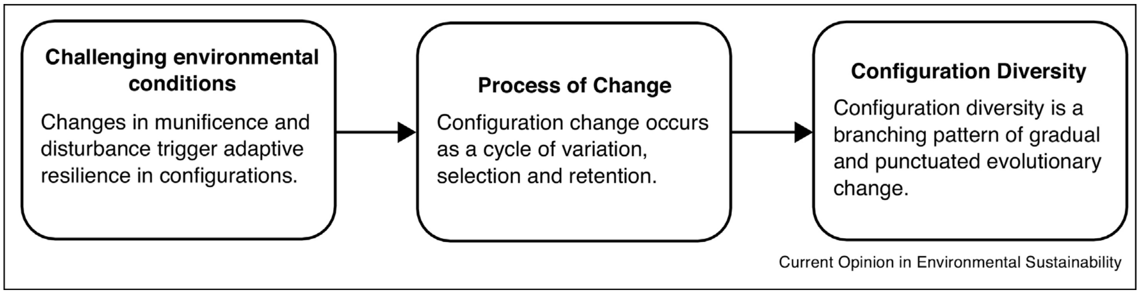
The configuration perspective views an organization as 'any multidimensional constellation of conceptually distinct characteristics that commonly occur together' [4: 1175]. This perspective has been used in operations management research for developing insights about the diversity and performance of different manufacturing configurations (e.g. mass producers, lean producers and agile producers) [9] and different supply chain configurations [10]. However, a review of published operations management studies revealed that the process of configuration change through time has been overlooked. Instead, the studies in question have focused on the relationship between the characteristics of a configuration and its performance.

Central to the motivation for configuration change in operations management is the concept of resilience. Here 'resilience' means the ability of a system to withstand changes in its environment and still function [1•,11]. Building on this definition, operations management researchers use the term 'organizational resilience' to refer to the ability of an organization to withstand disruption and maintain its original configuration *or* to develop a new configuration that better fits the new environmental conditions [12••,13,14,15••]. It is the second of these aspects of organizational resilience that we focus on in this paper, that is, adaptive organizational resilience.

An evolutionary framework of resilient configuration change

In this section, we present and explain the three components of our evolutionary framework: challenging environmental conditions, the process of change, and configuration diversity (Figure 1).

Figure 1



An evolutionary framework of adaptive organizational resilience.

Challenging environmental conditions: disturbance and munificence

Central to the phenomenon of resilience is the observation that challenging environmental conditions often generate and shape the essence of new manufacturing configurations [16]. Although change in configurations can be influenced by many different challenging environmental conditions, we suspect that a small number of dominant conditions will influence them at any one time [17]. We focus on two — disturbance and munificence. These conditions are recognized as important by evolutionary theories of change and are key factors for the resource and planning functions of manufacturing firms [18,19]. Significant changes in their levels can increase the vulnerability (expected harm) to which an organization is exposed and increase the potential for change [11].

Environmental disturbances have been defined usefully as 'transient perturbations whose occurrence are difficult to foresee and whose impacts on organizations are disruptive and potentially inimical' [20: p. 515]. They are events that negatively affect the normal operation of a manufacturing firm, such as earthquakes, industrial disputes, and regulatory changes. If sufficiently large and/or frequent, they may trigger organizations to try to generate new configurations.

Traditionally, operations management research has focused on frequent but relatively minor disturbances that influence demand uncertainty and/or scheduling and planning practices. Variation in orders, processing times, and equipment availability, and shifts in the dynamics of interaction among supply chains are good examples of this type of disturbance [21–24]. However, as manufacturing firms continue to serve and source from greater global markets, the risk and impact of major disturbances has increased. Consequently, operations management researchers have also begun to examine the impact of large environmental disturbances such as the downstream effects of the Bhopal and Exxon Valdez disasters [25], the impact of the 1973 oil crisis on automotive product strategies [26], and the consequences of the Tohoku Earthquake for supply chains in Japan [15••].

In the present context, munificence is the extent to which the resources available to a population of firms are abundant or scarce [27]. It influences how 'environments affect organizations through the process of making available or withholding resources, and organizational forms can be ranked in terms of their efficacy in obtaining resources' [28: p. 61]. High levels of munificence are associated with buffers that help firms absorb shocks and withstand disturbances. High levels of munificence are also associated with the 'organizational slack' that gives firms the confidence and energy to incrementally adapt their operations and products [29]. In other words, munificence can provide firms with the slack to refine existing configurations, but also the resources to buffer disturbances and maintain existing configurations. In contrast, scarce resources provide an impetus for firms to rethink their strategies and generate new organizational configurations.

Process of change: variation-selection-retention

The second component of our framework — the process of configuration change — draws on Campbell's [6] model of evolutionary change to explain how differences in disturbance and munificence act on the evolutionary processes of variation, selection, and retention to drive resilience-enhancing changes in organizational configurations. For a more detailed account see [28].

Variants result from the action of producing changes in the characteristics of a configuration. Variants can be resource-, routine-, or knowledge-based, and span all areas of manufacturing such as planning and control, supply chain management, facilities layout and job design. They can arise accidentally, or they can occur deliberately as managers try to produce change for better performance. A common source of intentional variants is the formal programs of innovation and change that managers put in place.

New variants can, singularly or in combination, result in new organizational configurations if they are selected and retained. Selection is a mechanism that determines which configurations or characteristics of configurations are viable, while rejecting those that are not. Selection functions through mechanisms such as market demand, competition pressures, and regulatory and technological standards. As these reduce variation in configuration characteristics and the number of viable configurations, environmental conditions such as munificence and disturbance will influence the rate of evolutionary change through the selection process and the type of configuration change that materializes. For example, even though high levels of munificence endow firms with the resources necessary to explore configuration change, it also potentially presents a weak selection process as there is limited struggle for resources. Therefore, a high level of munificence likely will result in little or no configuration change, as the relative comfort of the environment encourages managers to keep doing (or refining) what they always have done, that is, 'core rigidity' [30,31].

Retention is the mechanism by which selected configuration variants are adopted by organizations and industries. Within-organization retention is the ability of an organization to learn, practice, and accept changes in its configuration so that the variant becomes the new way of working. Across-organization retention is the process by which new practices and the resulting configurations are copied and spread within or among industries. Operations management researchers have examined the retention of new manufacturing practices and concluded that institutional forces dominate the retention of practices [32•]. The institutionalized retention of new configurations can be *mimetic* (firms copy desirable practices), *normative* (firms follow industry and professional standards), or *coercive* (customers, governments, unions, and other stakeholders compel firms to adopt practices) [33]. Institutionalized retention appears to be governed jointly by ecological fit (spatial and temporal factors) and social fit (values and beliefs) [34].

In sum, the variant-generation → selection → retention process is stimulated by changes in environmental conditions such as disturbance and munificence, and results in both within-organization alterations in configuration and shifts in the diversity of configurations in the population of manufacturing firms in a given industry [35••,36].

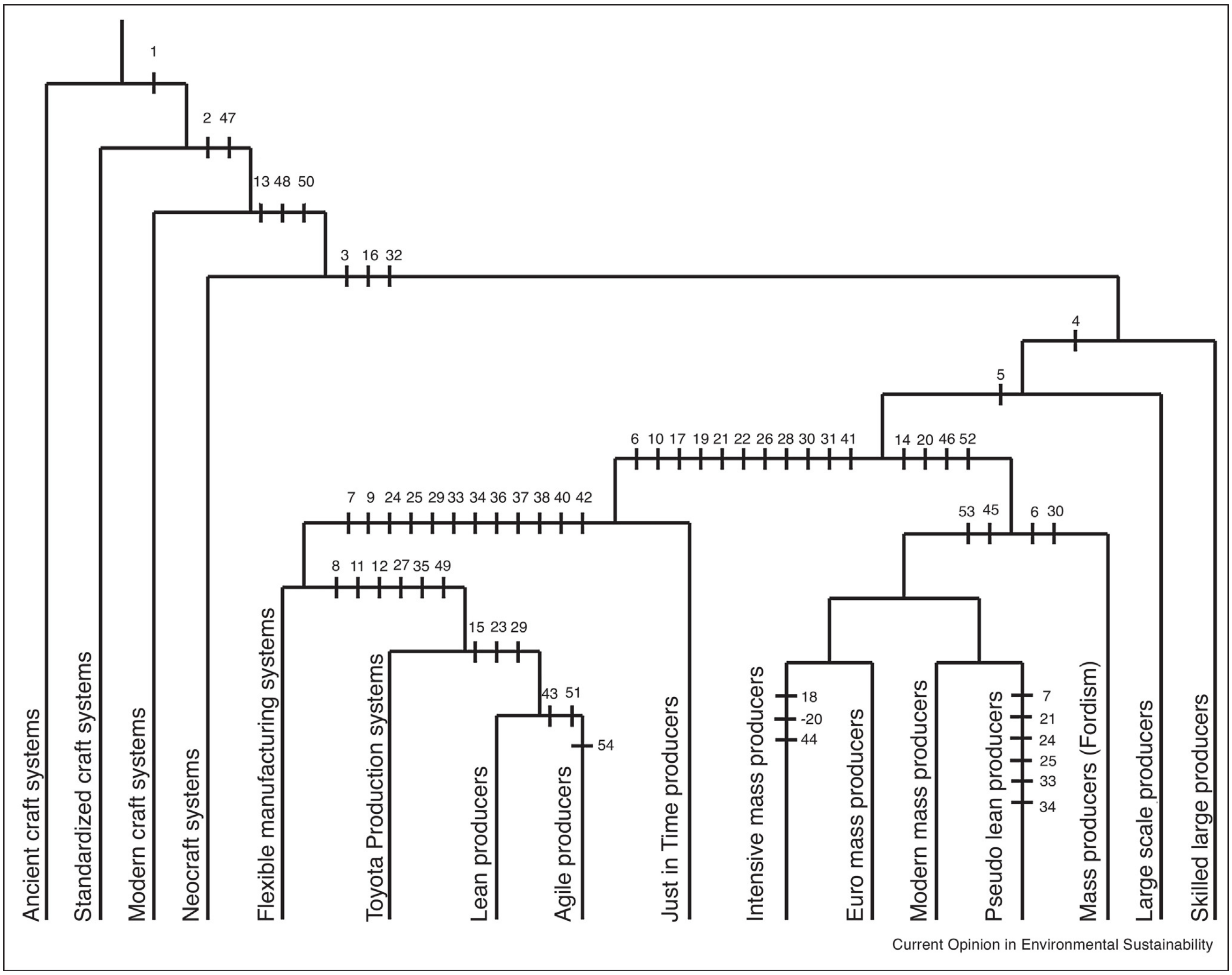
Configuration diversity: cladistics

The third component of our framework is concerned with understanding how the configurations produced from resilient adaptations differ from, and are related to, each other. This is a classification task whereby by descriptions, explanations, and predictions are made about configuration diversity. To accomplish this task, we suggest using a method from evolutionary biology called 'cladistics' [37]. In an operations management research context, cladistics involves clustering a group of configurations based on their evolutionary history or 'phylogeny,' and then tracing the shared derived characteristics from the groups' most recent common ancestor [7,9,38••]. So, while an individual automotive manufacturing company such as Ford will have a history, it is the evolutionary history of the different configurations this company has adopted overtime that we are interested in.

An example cladogram is shown in Figure 2 [7,9]. It presents a hypothetical classification of automotive manufacturing configurations based on the practices listed in Table 1. Producing such a classification involves five steps. First, one selects the sample of organizational configurations to be classified, that is, a sector that has experienced within-industry configuration change over time. Recent studies have used cladistics to map configuration diversity in the video games industry [39••], to classify risk management practices in the European and US banking industries [40], and to examine the concept of manufacturing agility [41]. Second, one has to choose the set of characteristics or 'characters' that will be used to reconstruct the relationships among the configurations in the sample (see Table 1). In evolutionary biological applications of cladistics, characters are things like the presence/absence of a wing, or the number of vertebrae. Here, the characters are the presence/absence of particular manufacturing practices. Third, one determines which of the states for each character is shared-primitive and which is shared-derived (e.g. 'absence' is shared-primitive and 'presence' is shared-derived). A shared-primitive character state is one that is shared by all focal configurations and therefore cannot tell us anything about their evolutionary relationships. A shared-derived character state is one that is exhibited by some configurations but not by all of them. Shared-derived character states are the key to determining the evolutionary relationships of a group of configurations because they allow subgroups to be delineated. The fourth and fifth steps of cladistics are, respectively, to construct all possible potential classifications or 'cladograms,' and then identify the most parsimonious of the cladograms.

A cladogram is a tree diagram in which the relationships among entities are represented by lines that cluster the entities into nested sub-groups (see Figure 2 for an example). Reading a cladogram is much like reading a family tree. The root of the tree is the *ancient craft systems* configuration, and all other branches from this point are descendants of this configuration. The cladogram depicts phylogenies for each of the configurations in the automotive industry. These branching patterns show the shared and the unique evolutionary history that configurations can have. For example, the *lean producer* and *agile configurations* share characteristics 29, 23, 15, 49, 35 and so on as

Figure 2



A cladogram of automotive manufacturing configurations based on the characters in Table 1.

traced back along those branches; but characteristics 43, 51 and 54 are unique to *agile producers*.

When constructing a cladogram, the principle of parsimony or 'Occam's razor' holds that when we are faced with multiple competing hypotheses we should always choose the simplest one as the working hypothesis. In cladistics, this means choosing the cladogram that requires the smallest number of character state changes. A central assumption in producing a cladogram is that the focal entities are all related to each other, that is, that they have all evolved from a common ancestor. In Figure 2, for instance, while *mass producers*, *lean producers*, and *flexible manufacturing systems* each have different configuration characteristics, their defining practices can be traced back to the *ancient craft systems* configuration. Another important point is that the defining character states of a configuration are not just the character states that differentiate it from other configurations. They also include the character states that extend back to the ancestor of the cladogram (e.g. the *ancient craft systems* in Figure 2). See [7,9] for more information on the cladistic method and the example automotive industry cladogram.

A typology of adaptive resilience

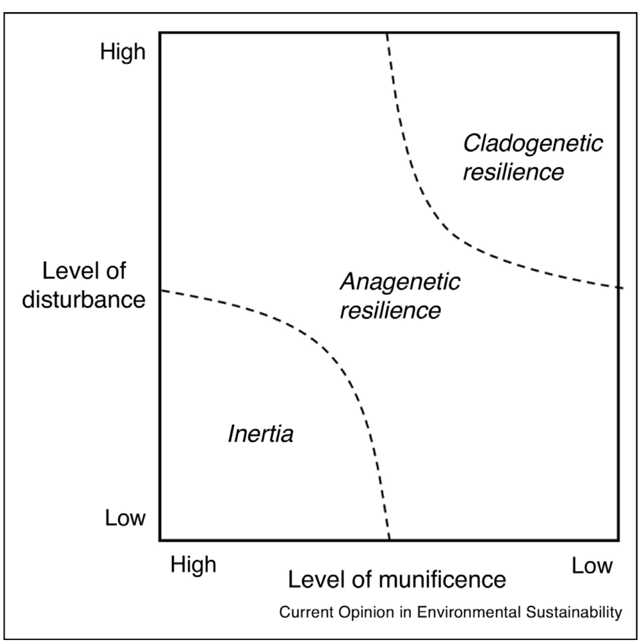
In the final section of the paper, we consider how shifts in disturbance and munificence impact the rate and amount of configuration change, resulting in a typology of two forms of adaptive resilience (anagenetic resilience and cladogenetic resilience) and one form of resistance or inability to change (inertia) (see Figure 3). Anagenetic resilience and cladogenetic resilience are comparable to the adaptive-transition-change pathways discussed in sustainability research [42].

Table 1

Automotive manufacturing configuration characteristics

1. Standardization of parts	30. Preventative maintenance
2. Assembly time standards	31. Individual error correction — products are not rerouted to a special fixing station
3. Assembly line layout	32. Sequential dependency of workers
4. Reduction of craft skills	33. Line balancing
5. Automation (machine placed shops)	34. Team policy (team motivation, pay and autonomy)
6. Pull production system	35. Toyota verification of assembly line (TVAL)
7. Reduction of lot size	36. Groups vs. teams
8. Pull procurement planning	37. Job enrichment
9. Operator based machine maintenance	38. Manufacturing cells
10. Quality Circles	39. Concurrent engineering
11. Employee innovation prizes	40. ABC costing
12. Job rotation	41. Excess capacity
13. Large Volume Production	42. Flexible automation for product versions
14. Suppliers selected primarily by price	43. Agile automation for different products
15. Exchange of workers with suppliers	44. Insourcing
16. Socialization training (master/apprentice learning)	45. Immigrant workforce
17. Proactive training programs	46. Dedicated automation
18. Product range reduction	47. Division of labour
19. Automation	48. Employees are system tools and simply operate machines
20. Multiple sub-contracting	49. Employees are system developers — motivated and managed they can solve problems and create value
21. Quality systems (procedures, tools, ISO 9000)	50. Product focus
22. Quality Philosophy (culture, way of working, TQM)	51. Parallel processing (in equipment)
23. Open book policy with suppliers. Sharing of cost data and profits	52. Dependence on written rules — unwillingness to challenge rules such as the economic order quality
24. Flexible, multi functional workforce	53. Further intensification of labor — employees are considered to be machines and will be replaced by a machine if possible
25. Setup time reduction	54. Open and responsive technology systems
26. Kaizen change management	
27. TQM sourcing. Suppliers selected on the basis of quality	
28. 100% inspection/sampling	
29. U-Shape layout	

Figure 3

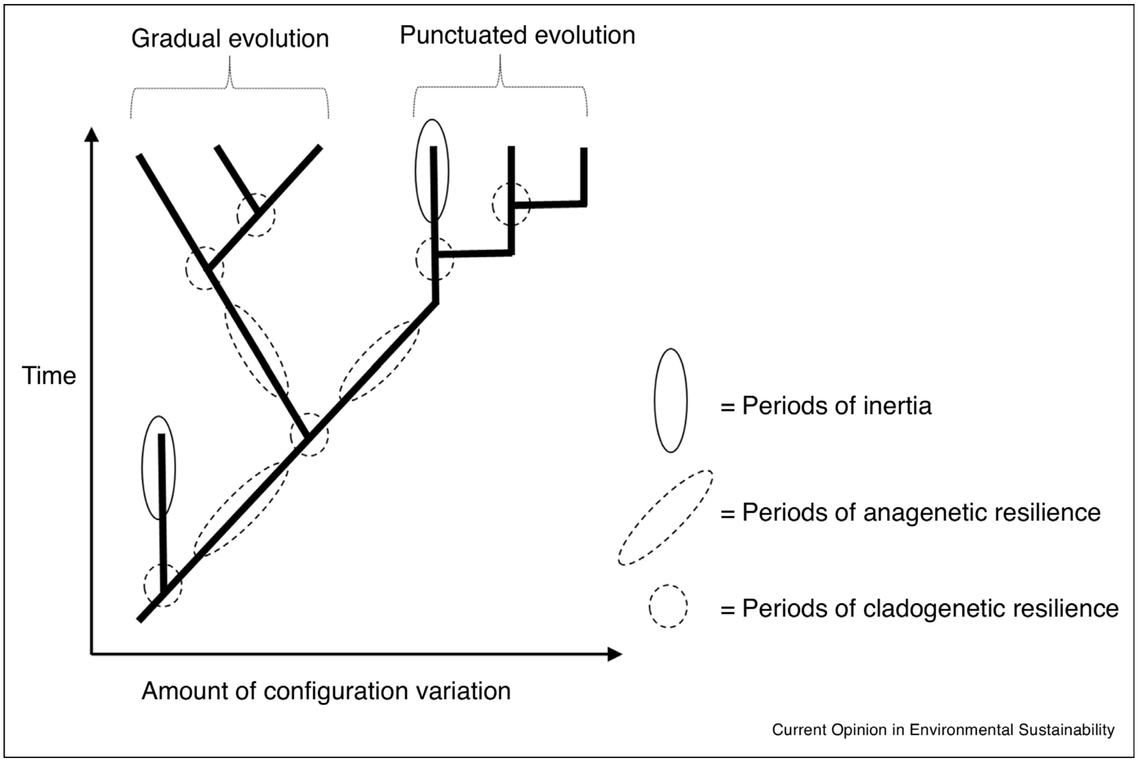


A typology of adaptive organizational resilience.

To help understand how these processes vary in terms of their rate and amount of configuration change, we present a phylogram (Figure 4). A cladogram depicts only branching patterns of configuration change; the lengths and spacing of the branches do not represent any information. In contrast, in a phylogram the branch lengths and spacing convey information about the amount and rate of configuration change. Phylograms typically include scales to specify the rate and amount of change by the length and divergence of the branches. Hence, Figure 3 depicts the conditions that induce different types or modes of configuration change, while Figure 4 shows the rate of change. Gradual evolution is when the amount of configuration change is small compared to that of time. In punctuated evolution, periods of inertia are interrupted by bursts of change. In the latter episodes, the amount of change is very large relative to the amount of time elapsed.

In Figures 3 and 4, cladogenetic resilience refers to the formation of a new organizational configuration, whereby a parent configuration branches to produce a daughter configuration. This increases the diversity of organizational configurations in a population by one, and adds a branch to the cladogram. For example, the shift from the

Figure 4



A phylogramatic representation of adaptive organizational resilience.

ancient craft systems to *modern craft systems* involves two instances of cladogenetic resilience in the history of automobile manufacturing configurations. First, there is a branching point after characteristic 1 that spawns the *standardized craft system* configuration; and second the branching point after characteristic 47 (see Figure 2) that produces *modern craft systems*. We suggest this type of adaptive resilience occurs when the level of disturbance is relatively high and the level of munificence is relatively low.

Anagenetic resilience differs from cladogenetic resilience in that it involves one configuration evolving into another through a series of incremental changes along an unbranching lineage. For example, in Figure 2, the refinement of the *mass producers* configuration involves the unbranching accumulation of characteristics 7, 21, 24, 25, 33 and 34. We suspect this process of anagenetic resilience occurs when the level of disturbance is moderate to high and the level of munificence is low to moderate. As the level of disturbance increases and the level of munificence decreases, so will the rate of progression along the lineage, as well as the potential for cladogenetic resilience.

Organizational inertia is generally defined as resistance to change, and involves an organization persisting with its current configuration and repeating past strategies and practices [43]. It occurs because a configuration is not exposed to significant enough forces for change and thus maintains its identity. In an evolutionary context, inertia refers to limited future branches and the perseverance of existing characters, until an external challenging condition acts to change this [44]. Consequently, we suggest in Figures 3 and 4 that inertia is a type of non-adaptive or resistant resilience (inertia) that occurs when the level of disturbance is relatively low, and the level of munificence is relatively high.

Conclusion

Given the shortage of research on how organizational resilience functions, our aim for this paper was to develop a theoretical framework for describing and explaining the process. We used configuration theory and evolutionary theory to develop a framework for understanding the process of adaptive organizational resilience. The framework seeks to understand adaptive resilience in terms of the challenging environmental conditions that trigger configuration change; the process by which the change is created, selected and replicated; and a classification method for mapping and ordering the resulting diversity. We have also presented a typology that provides a systematic way to contrast how differences in munificence and disturbance can be linked to the degree or extent of configuration change and the types of adaptive organizational resilience. We hope that the framework we have outlined will generate more theoretical interest in the intriguing and important process of adaptive organizational resilience.

Conflict of interest

None declared.

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