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UNRAVELING ORGANIZATIONAL DYNAMICS UNDER UNCERTAINTY

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Purpose: In recent years, uncertainty has become an indispensable, if not dominant, component of business activities. The aim of the research is to conceptualize the organization's responses to conditions of high uncertainty.
Design/methodology/approach: The approach adopted involves literature review, including an interdisciplinary ground of complexity theory.
Findings: The content of the article presents the sources of the dynamics of the organization. The considerations are based on interaction between organizational schemata and routines. Capturing the interactions among schemata and routines made it possible to systematize the possible responses (strategies) of the organization due to the uncertainty.
Research limitations/implications: The results of the study are presented in the form of theoretical framework pending further testing.
Originality/value: The obtained research results give an insight into the ways in which decision-makers enact strategic intents and thus give a better understanding of how the organizational development trajectories are shaped. The formulated conclusions may be particularly valuable in relation to the organization's behavior in conditions of high uncertainty, both in terms of management theory and guidelines for practical operation.

Keywords: uncertainty, schema, routines, complexity.

Category of the paper: Conceptual paper**.**

1. Introduction

Adaptation of the organization and the environment is one of the central problems of strategic management. Initially, the mainstream research on strategies concentrated on methods of determining efficient goals and effective ways of achieving them. The reason why strategic management began was the need to respond to growing uncertainty that made the organization’s development trajectories more and more different from the assumptions made (Rokita, 2005). Uncertainty became a significant determinant of strategies, however, its high states, although

identified, have not been intensively explored. Uncertainty was perceived as result of a gap of knowledge that had to be closed through learning processes, resulting in better theories and greater methods of analysis (Boisot, McKelvey, 2009). At the core of this research approach was the assumption of fixed mechanisms striving for equilibrium (Parker, Stacey, 2007), and their discovery provided opportunities to predict future and thus control the organization's actions. Knowledge, or understanding of the situation was identified with the ability to predict future behavior. Such a definition of "understanding" means de facto that the future exists in the present time and is therefore determined (Allen, Boulton, 2011, p. 164).

The events of recent years have put these fundamental assumptions to the difficult test. Observation of business practice suggests that the dominant aspect of managers' daily struggles nowadays is to face situations that dramatically throw their organizations off the expected development paths. The reasons for change are events that they did not take into consideration when thinking about the future of their organizations, or even if they did, they regarded them as too unlikely to prepare alternative scenarios for such circumstances (Andriani, McKelvey. 2011; McKelvey, Boisot, 2009). Therefore, when confronted with so-called black swans, organizations lack the resources that would help to overcome emerging threats frequently leading to a deep crisis. At this point, it is worth highlighting the fact that disasters and crisis they cause are unique phenomena by nature, i.e., they are not repetitive. The empirical context of contemporary economic practice, to mention (just) the COVID-19 pandemic, climate change or the war in Ukraine, urges us to take up, on the ground of theory, the classic problem which are resources of an organization in a broad sense needed for effective adaptation in a highly uncertain environment. The self-study whose results are contained in the body of the article, are intended to answer the following question: Is it possible to identify the resources of the organization that are essential for its adaptation under high uncertainty, and if so, in what form? The objective of the consideration is, based on literature studies, the conceptualization of the organization's responses to the conditions of high uncertainty (chaos). This concept may enrich the literature on the subject for two reasons. Firstly, the issue of how decision-makers in the organization enact their plans remains relatively less recognized in relation to how strategic intents are formulated (Weick, 2001; Tsoukas, Chia, 2002; Rerup, Feldman, 2011). Secondly, while the mechanisms and resources of organizational changes used within their framework have been recognized under relatively stable operating conditions, understanding organization's responses to the conditions of high uncertainty remain understudied both at the level of theory (Andriani, McKelvey, 2011) and guidelines for practical action (Snowden, Rancati, 2021).

Considerations on the organization's adaptation under high uncertainty were based on so-called schemas. Schemas are knowledge structures that organize past and future experience needed to act in the present. It can be said "schemata act as data reduction devices enabling individuals to negotiate a complex and confusing world" (Balogun, Johnson, 2004, p. 525). Routines, which constitute part of the resource theory in management science (Orlikowski,

2000; Feldman, 2004), have been adopted as the manifestation of schemata in the organizational context. Organizational routines are understood here as repetitive, recognizable patterns of interdependent actions carried out by multiple actors (Feldman, Petland, 2003). Schemas and routines are related though not unambiguous concepts (Rerup, Feldman, 2011). Taking into account both categories makes it possible to obtain better theoretical coherence in the concept of the organization's response to the conditions of uncertainty, and to combine considerations at the theoretical level with specific empirical context.

2. Expanding the boundaries of knowledge about uncertainty based on complexity theory

Thinking about uncertainty frequently falls into a dichotomous framework in which it is defined as the opposite of certainty. However, in-depth studies on the nature of uncertainty make it possible to distinguish various intensities and types of uncertainty (Jędralska, 2010). The boundaries of our understanding of uncertainty are expanded by a relatively new discipline of knowledge, i.e., complexity theories which encourage us to reinterpret the assumptions made in the research (Rokita, Dziubińska, 2017). Axelrod and Cohen (1999) mention three ontologies related to fundamentally diverse states of systems: order, complexity, and chaos. Ordered systems are ones in which the relationship between causes and effects is known or discoverable and empirically verifiable. These known relationships are repetitive therefore it is possible to construct prescriptive models of system behaviors on their basis - prediction understood as identification of future phenomena with specified precision is possible (McKelvey, Boisot, 2009). Complex and chaotic systems, so-called systems operating under conditions far from equilibrium, are uncertain by their nature. Complex adaptive systems (CAS) are created by agents that remain in constant interaction. The nature of agents and the amount of interaction mean that the relationships between causes and effects, although they exist, cannot be clearly identified ex ante (consistent patterns can be identified retrospectively). These systems are disposed to certain behaviors more than others (but not predisposed). The states of the system are not subject to prediction, but their anticipation is possible - orientation about classes or events (McKelvey, Boisot, 2009).

Various definitions of CAS are possible (Maguire, 2011). One of the ways is to identify them through rules that constrain agent behavior. In complex systems the rules of the system constrain to a certain extent agents' behavior (although to a lesser extent than in the case of ordered systems), yet agents' behavior also results in a change in these rules - they co-evolve. Due to its properties, the ability to control CAS based on traditional models is not possible, there is no way to discover order in the sense of static structures (inherent in ordered systems). However, it is possible to identify patterns that can constitute the basis for a "sufficiently

complex agent's response to the complexity of the environment" (Gell-Mann, 2002, pp. 16-17). These patterns - schemas are not subject to design, but when identified, they are prone to intervention. It is possible to create conditions for development and strengthening of patterns whose emerging results are regarded as desirable and quenching undesirable ones. In chaotic systems, the ability to act intentionally is far limited, as the relationship between causes and effects is not discernible. Therefore, it is impossible to choose and apply procedures grounded in past experience (as is in the case of ordered systems), and there is no indication which behaviors the system is more disposed to than others (as in complex systems).

The theory of complex and chaotic systems provides opportunities to better understand the nature of uncertainty. It should be noted that within the framework of the complexity theory, two streams of research are developing in parallel. The first one is so-called mathematical study on complex systems, based above all on agent simulation methods. The second is research in the social complexity stream that takes into consideration the fact that peoples as agents and the systems they create are characterized by unique properties to which simulation methods provide very limited, or reduced, insight (Morin, 2008; Stacey, Mowles, 2016).

The metaphor of chaos became a fruitful basis for deepening knowledge about organization's dynamics under high uncertainty conditions in organizations (Stacey, 1992; McKelvey, 2001; Rokita, Dziubińska, 2016; Snowden, Rancati, 2021). Due to the natural ability of social systems to self-organize, chaos is always a transitional state, although the emerging new order is created in an unexpected and surprising way. In social systems, a less "organic" trajectory of recovery from chaos is also possible, which is the imposition of hard leadership and concentration of agents' actions on one vision of the future (Kurtz, Snowden, 2003). The organization can fall into this state due to its internal dynamics or some event in the external environment. In such cases, we are dealing with circumstances traditionally associated with a crisis that poses a real threat to the organization's survival. The state of chaos may also be an element of intentional management of the organization. Periodically putting an organization into a state of chaos creates the potential to break established rules of behavior, stimulate creativity or train the organization to deal with unpredictable circumstances. Then it becomes an opportunity since only under such conditions is it possible for something new, a true novelty, to emerge (Kurtz, Snowden, 2003).

Although the category of chaos has found its place in the research on the dynamics and even strategies of the organization, there is still no in-depth conceptualization of mechanisms which are behind these dynamics. This issue has been addressed most comprehensively to date by Stacey within the framework of his concept of responsive processes, but he focuses more on the natural play of "order" and "chaos" inside an organization (Stacey, Mowles, 2016). Boisot and McKelvey (2011) also address this problem within the framework of a model which they called the Ashby space, but they reduce the response of living organisms to chaos to purely behavioral categories. They recommend reduction which makes it possible to move to the complexity phase without including in the model the consideration of possible mechanisms for

this transformation. The most pragmatic approach towards coping with the chaos inside an organization was proposed by Snowden (Snowden, Rancati, 2021) based on the Cynefin framework, which he most briefly summarized in the form of heuristics: act - sense - respond (as opposed to heuristics specific to the ordered domain: sense - categorize/analyze - respond, and heuristics specific to the complex domain: experiment - sense - respond. According to the author's proposal, management methodologies consist in changing the disposition of the system through identification and intervention in organizations' narratives. Rokita and Dziubińska (2016) conceptualize the strategy as social practice and a way of coping with diverse organizational dynamics and propose solutions within system theories.

3. Management under ordinary and extraordinary conditions

In thinking about uncertainty, the fundamental boundary is set by the possibility to measure it on the basis of calculus of probability (Knight, 1921).[1] Systems are perfectly predictable (known) when the laws governing their behavior have been identified, and the determinants of their behavior (at any point in time) conform to these laws. Predictability takes place here in a fundamental sense - precise prediction is possible. In these states of the system, thinking in terms of clear-cut relationships between causes and effects is effective and justified. When systems corresponding to such a model, as a result of some event in the environment, are thrown out of equilibrium, they begin to exhibit irregularities. Unlike in the previous case, time starts to be of the essence with regard to the periods during which these systems seek to adapt and return to the state of equilibrium. In the systems moving back toward equilibrium, the probability calculus is justified as the basis for formulating forecasts of system behavior (such a system makes many repetitive movements on its way toward equilibrium). We can conclude from the above that the dynamics of systems close to equilibrium have two components. The first is the laws governing the system reflecting regularity (disturbed to a minor extent by noise), and the other is random crises (shocks) coming from outside the system, responsible for throwing it off its regular trajectories of development. Therefore, the greatest difficulty in forecasting relates to the environment, and tackling uncertainty consists in reducing ignorance as much as possible by collecting more information and conducting more sophisticated analyses. Reality deviates from expectations but if the causal model is good enough, the deviation ("experimental error" or "noise") will be relatively insignificant and possible to ignore - reality is a knowable unknown. What is more, this experienced irregularity should be regarded as an expression of incompetence, revealing poor preparation for change. The situation is different in the case of systems far from equilibrium, in which the relationships between causes and effects are lost in the complexity of interactions within the system itself and between systems. Therefore, forecasting is not possible because these systems are

unpredictable in their very nature (systems are unknowable). Chaotic states of the system mean that irregularities in the system's behavior are not caused by ignorance or incompetence, but by the very nature of the system. From the detail of interaction, patterns of behavior emerge over long periods of time, however, they are of qualitative nature. Stacey (1996) links the three situations to the three types of changes that decision-makers face, i.e., closed, contained and open-ended changes.

Actions on either side of the boundary separating situations where measurement of uncertainty (and thus prediction) is possible from those that are "unknown," require distinct approaches towards management - different ways of making decisions and exercising control (Raisch et al., 2018). The boundary separates the conditions of ordinary operation of the organization and an emergency - a crisis (Stacey, 1992). Ordinary management is executed in the conditions of a relatively stable (predictable) everyday life, which favors the consolidation of organizational consensus around executed modes of operation of the organization and its strategic perspectives. Extraordinary management is activated by tensions imposed on the organization which forces it to challenge prevailing paradigms (Boisot, McKelvey, 2011). Both processes are "based on judgment of what is important" (Gell-Mann, 2002, p. 15). Ordinary management is similar to the model of rational decision-making processes providing harmony, adjustment and convergence of organization's configuration. Thanks to relative stability, the process is progressing in an incremental manner. Here, the choices are made according to criteria more or less corresponding to technical rationality since there is a dominant agreement within the organization about the significance of factors embedded in the environment and the actions carried out by the organization. Extraordinary management takes place outside the rules of existing paradigms. In this mode, paradigms are questioned and broken down, and new paradigms are created in their place. Rational analysis is not applicable in this situation as no one knows the result of the process (no one is able to predict which new paradigm will be shared). Instead of the analysis, the process of frame-breaking, persuasion, conversation, which is vulnerable to the leader's influence, proceeds. Destabilization and irregularity appear instead of coherence and harmony. Ordinary incremental management with competitive trial-and-error experiments is bound to uncover anomalies and so leads to crisis and revolution (Stacey, 1996, pp. 192-205). Paradigms cannot be changed in an incremental manner (not to mention the fact that the change does not yield to design), but rather, after a long period of struggle, they appear in a "sudden enlightenment".

In case of humans (and other living systems) responses in emergency situations do not need to be rational, and most frequently are not (Bratnicki, 2020). Such a response can be a mix of behavioral and cognitive behaviors (or even run outside of cognitive control) relevant to how a given event is classified. The response that follows is a reaction to representations of the environment that are constructed as a result of classification actions and not directly to the environment (Plotkin, 1993). These representations are "appropriately complex schemata" – structured descriptions of the outside world which contain neither too few nor too many degrees of freedom (Ashby, 1963, p. 207; Gell-Mann, 2002, pp. 16-17; Maguire, 2011).

4. Sources of organizational dynamics

The basis for formulating predictions and then acting can be found in schemas, which can be described as descriptions of world "regularities." The problem of schemata (or, among other things, mental models, behavioral scripts, paradigms, mental maps) has been addressed in various disciplines of science (including system thinking, psychology, cognitive science, management), and has also become a significant element of complexity theory. For instance, in science schemas appear as equations, in culture as laws, customs, memes, in management as strategies, and in an organization as routines.

An example of a definition built on an interdisciplinary basis specifies schemas (mental models) as concentrated, personally constructed, internal conception, of external phenomena (historical, existing of projected), or experience, that affects how a person acts (Rook, 2013). As can be seen from the definition cited, schemata are unique constructs that agents attempt to fit over the realities of the world. The small-scale representations of external reality are often incomplete conceptions of external phenomena and constitute subjective interpretations of experience. These constructs change depending on the agent's orientation - past, present and/or future. An important feature of schemata is the fact that they affect how agents act, and that selected actions become inter-actions.

Schemata play a key role in the development of the system, although the roles may differ from one another depending on the situation of the system. Schemas are filters on the basis of which it is possible to distinguish information that is meaningful (covering "important" regularities) from the rest. This makes not only any response possible but, above all, one that economizes on agent's scarce resources. Effectiveness understood in such way is primarily justified in the face of closed and contained changes described in the previous section. Identification and selection of the appropriate schema guarantee the use of the right (best or good) practice (in this sense, the model precedes the action). The situation is different in the case of open changes, when there is no basis for transferring the developed schemata based on past experience into the future. The relative increase in possible states of the environment requires that the adapted system generate an appropriately diverse response (according to the thesis that "only variety can destroy variety;" Ashby, 1963). For successful adaptation the existing schemata must also be open to change or the emergence of wholly new ones (therefore, it can be said that the action takes place in parallel with the emerging frames of reference).

Schemata are most frequently presented as phenomena embedded in individual cognitive structures, but there are collective processes of socialization and exchange of information in systems of mutual interaction. Therefore, schemata are simultaneously an individual trait and collective frame of reference. Schemata (behavioral scripts, operating rules) can be shared in the form of bureaucratic rules or manifest themselves in the form of culturally established action guidelines (heuristics). Interactions and the systemic dimension of the phenomenon are one of

the premises for the study on organizational schemata. At this level, schemata were identified as shared assumptions, values, and frames of reference that give meaning to everyday activities and guide how organization members think and act (Bartunek, 1984; Rerup, Feldman, 2011). In the context of an organization, actions are oriented towards the realization of organizational intents, hence they are undertaken in the specific logic of organizational routines. Through enactment schemas undergo adaptation (Maitlis, Sonenshein, 2010) - actions can also be conditioned by schemata and can lead to their revision. In the context of an organization, actions are oriented towards the realization of organizational intents, hence they are undertaken according to the specific logic of organizational routines. Schemata are of universal nature and can form relationships with various specialized routines – routines are therefore manifestations of organizational schemata (to the extent specific to a particular routine) (Balogun, Johnson, 2005; Rerup, Feldman, 2011).

Flexible use of routines is the core of improving organizational task execution (Canales 2011; Howard-Grenville, 2005; Turner, Rindova, 2012), and their use is inherently grounded on action, surprise and creativity. They take the form of recognizable patterns, and at the same time are part of messy, unpredictable situated actions (Cohen, 2007). Routines account for both organizational change and stability (Feldman, Pentland, 2003). Complex dynamics of routines result from a generative mechanism that consists in the interaction of two of their aspects, i.e., the ostensive and the performative (Feldman, Pentland, 2003; Pentland, Feldman, 2005). The ostensive aspect is an abstract, generalized idea of routine in the form of a codified standard procedure or an unquestioned standard that is taken for granted. The ostensive aspect may also contain a significant tacit component embedded in the procedural knowledge (Cohen, Bacdayan, 1994) and the subjective understanding of various participants in the routine (Berger, Luckmann, 1996). The sense embedded in ostensive patterns is of emergent nature and depends on the point of view of those who participate in action. Consequently, there are many ostensive aspects, they are diverse and none of the routines is a single entity (Pentland, Feldman 2005). The performative aspect consists of actions in the specific context of time, place and people participating in the process. The characteristics of these two dimensions of routines can be summarized as the classically adopted division between “know how” (ostensive part) and “know that” (performative part) (Ryle, 2000). Taking into consideration both aspects of routines simultaneously (as opposed to obscuring one of them) helps to better understand the nature of dynamics - the transition of organizations between various states - the play between stability and change.

5. Intentional agent's responses (strategies) to uncertainty

Interactions between ostensive and performative aspects of routines may serve as the basis for determining the types of routines according to the intensity of uncertainty. As included in table 1, interactions between routines and schemas can be "open" or "closed" (cf. Stacey, 1996).

Table 1.
Types of organizational routines by intensity of uncertainty

Two aspects of routines →		**Ostensive aspect (set of outcomes) – "know that"**	
↓	Relationship of organizational routines and schemas (changes at different levels)	Closed	Open
Performative aspect (set of options) – "know how"	Closed	(1) Routines as good practices	(3) Routines as improvisation (exaptation)
	Open	(2) Routines as a result of trial-and-error learning	(4) Routines as frame-breaking (true novelty potential)

Closed interaction signifies relative compatibility of schemata and routines (it is possible to predict the course of routines on the basis of schemata and the execution of routines does not result in changes in schemata). This is obviously a certain simplification, as in practice unexpected phenomena cannot be excluded (due to human agency, neither routines nor schemata are ever completely deterministic). Closed interaction between routines and schemata leads to action based on prior learning to reduce range and variety of factors of the context of action (e.g., matching complementary tangible resources) and simplification of necessary schemata (e.g., development of detailed procedures describing actions). Schemas make "decomplexifying complexity" possible (Morin, 2007), at the level of routines. This is an example of exploitative learning (Holland, 1975; March, 1991).

Open interaction signifies that it does not proceed in a foreseeable manner. Open interaction between routines and schemas initiates exploratory learning (Holland, 1975; March, 1991). The objective of undertaken actions is explicitly divergent as agents "can hold multiple and sometimes conflicting representations" of routines (Boisot, Child, 1999, p. 238). The process of critical reflection on inherently limited knowledge is embedded in intentional actions (Cilliers, 1998, 2000). The overlapping of these two dimensions makes it possible to distinguish four types of routines, i.e.,

- routines in the close form, so-called good practices,
- routines shaped by the undertaken experiments (i.e., trial-and-error learning outcomes),
- routines as emerging in the process of improvisation (adaptation of known solutions to new conditions, that is, so-called exaptation),
- routines leading to unexpected, novel results.

Observation of organizational routines sheds light on the determinants of organizational dynamics, whereas studying the relationship between routines and schemas provides insight into its adaptive strategies. Choices guided by schemas lead to actions - they are certain strategies adopted by agents to achieve adaptation in the most profitable way possible. An "intelligent" agent's response to uncertainty consists in their ability to notice meaningful patterns (regularities), develop adaptive schemas, and generate an effectively complex response, i.e., one that effectively corresponds with the environment (Boisot, McKelvey, 2011, p. 287). Under ordinary conditions, the repertoire of schemas that the organization possesses is usually sufficient. The key is to identify what the challenge is, and the other steps are taken according to known routines, without their modification (box [1] in table 1), or with modification within the framework of a conceivable experiment (box [2] in table 1). The conditions of higher uncertainty broaden the scope of the information which must be processed by the agent before generating a response. As a result, schemas become more complex (Gell-Mann, 2002). They are more open to change, whereby the intensity of uncertainty conditions the strength of interference with schemas. The ability to identify potentiality effective routines (or their part) allow them to be creatively adapted to the new conditions (exaptation, i.e., adaptation to a new function) - box [3] in table 1. From the perspective of making choices, the most difficult situation is the one in which there is no basis for a cognitively driven response understood as some form of uncertainty reduction - box [4] in table 1 (neither prediction nor anticipation is possible) In this situation, the agent may withhold a response until identifiable patterns emerge (wait-and-see). However, in practice, such a response is not always possible. The alternative is a behavioral response, i.e., taking action which is "a blind step" (this strategy is described by Boisot and McKelvey (2011) as a "headless chicken response"). However, this move can also be looked at in a different manner - as the first element of act-sense-respond heuristics (Kurtz, Snowden, 2003; Snowden, Rancati, 2021). From a practical standpoint, the resources sacrificed in interaction with the system, e.g., the consequences of a poorly selected routine are the price of effective knowledge of system conditions. There is a reversal of the sequences with regard to those illustrated by the boxes [1] and [2] - table 1 - action precedes interpretation and response. This strategy is the intentional absorption of uncertainty (as distinct from its reduction in a certain form) (Boisot, Child, 1999; Dziubińska, 2020) "to generate new insights, and contribute to expanding the possibilities for thought and action" (Tsoukas, Hutch, 2001, p. 981).

6. Summary

The necessity to formulate future-oriented business intents is the very essence of strategic management. The high intensity of uncertainty, however, reveals limited, under these

conditions, effectiveness of the theories and tools commonly applied to date to help to formulate accurate predictions. The relatively new area of knowledge, i.e., complexity theories, provides an interesting research perspective in this regard. In management sciences, CAS have become a fruitful theory-constitutive metaphor which shifts thinking into a different ontology - a different logic of explanation more suitable to all historical, contextually embedded processes, including action. Under high uncertainty, concentrating attention on the mechanisms of organizational dynamics is essential, as the deliberate response of the organization to the environment is only possible on the basis of direct interaction with it. Strategic intents do not result from scrupulous plans but co-evolve with the emerging circumstances The resources that prepare the organization for such circumstances are adequate (appropriately complex) organizational schemas.

Schemas are the basis for action and its effect at the same time. Within an organization, actions are integrated with the execution of particular tasks embedded in organizational routines. The relationships between schemas and routines play the role of interlevel causality specific to complex systems. "Interaction among certain dynamical processes can create a system-level organization with new properties (…). In turn, the overall dynamics of the emergent distributed system not only determine which parts will be allowed into the system: the global dynamics also regulate and constraint the behavior of the lower-level components. (…) The more complex a system, the more states and properties it can manifest: novel characteristics and laws emerge with organization of the higher level." (Juarrero, 1999, pp. 5-6). Actions forming sequences of routines as lower, motor-level implementations of higher-level intentional causes, reconceptualizing mental causation in terms of top-down dynamical constraints can fundamentally recast thinking about developing strategical potential of organizations. Including reflections, enablers and constraints within the scope of intentional elements of management is an interesting research problem that requires further exploration. Their conceptualization based on the relationship between schemas and routines provides a convenient basis for this.

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Footnotes

1. In his seminar study, Knight (1921), based on the probability theory, distinguished three situations, i.e. probabilities determined a priori, statistical probabilities and estimates. The first relates to completely homogeneous classifications of completely identical cases, except for factors that are truly indeterminate (p. 224). Statistical probabilities correspond to high levels of confidence that proportions discovered in the past will be sustained in the future, still based on a priori judgments about indeterminacy (p. 125). Estimates consist of decision makers' judgments about the occurrence of cases.