



**Dynamic Environments and Complexity-Embedded Strategies**

*The dynamic, ever changing environment requires strategies that are emergent,  
and based upon complexity sciences*

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## Dynamic organisation environments and developing complexity-based strategies to attain simple rules for greater effectiveness

A great deal of research shows fundamental tension between too little and too much structure (Davies, et al, 2004). The tension is apparently caused by the tradeoff between organisational flexibility and efficiency that is central in dynamic markets. Some of the interesting findings in this regard suggest, an inverted U-shaped relationship exists between performance and the amount of structure. Additionally, this relationship seems unexpectedly asymmetric, i.e., it is better to have too much structure than too little. Second, increasing unpredictability is associated with less optimal structures. Moreover, when environments are very unpredictable, there is a very narrow band of optimal structure, i.e., the “edge of chaos” (EOC). Lastly, increasing velocity (rate of change) raises performance while increasing complexity lowers it. Surprisingly, increasing ambiguity diminishes the value of skill.

Emerging theories suggest how organisations can adapt by building on the insights of complexity science. A adage of strategy and organisational theory debates the amount of organisational structure shaping performance in dynamic environments, with research findings suggesting a fundamental tension between possessing too little and too much structure (Burns and Stalker, 1961; Henderson and Clark, 1990; Uzzi, 1997). On the other hand, entities having too little structure seem to lack leadership and guidance to generate efficient behaviors (Sine, Mitsuhashi, and Kirsch, 2005). Thus organizations having too much structure are too constrained and lack flexibility (Miller and Friesen, 1980; Siggelkow, 2001; Rivkin and Siggelkow, 2003). This tension creates a dilemma for organisations competing in dynamic environments as success requires both efficiency and flexibility.

Some studies show that high performing organizations resolve this tension by using a moderate amount of structure to improvise a variety of innovative solutions (Brown and Eisenhardt, 1997). Overall, this is suggestive of an inverted U-shaped relationship between the amount of structure and performance at work, and has been observed in diverse research streams, e.g., Weick’s (1976) whose loose coupling ideas focus on the benefits of moderate intra-organisational connectivity in that loosely coupled units are responsive enough to remain coordinated, but possess enough separateness to act innovatively and independently as well (Orton and Weick, 1990; Schilling and Steensma, 2001; Gilbert, 2005). Other research emphasises moderate connectivity among parts of an organisation (Hansen, 1999; Galunic and Eisenhardt, 1996, 2001; Rivkin, 2000). Similarly, studies in Taiwan, found most innovative groups were those with semi-linked operating and director relationships allowing shared access to financial resources among affiliates (Chi-nien, et al, 2005). Moderate amounts of external connectivity are also beneficial (Hargadon and Sutton, 1997; Owen-Smith and Powell, 2003).

The tension between too little and too much structure is also observed in research on improvisation, which is concerned with how partial structure guides behavior in real-time (Weick, 1998; Miner, Bassoff, and Moorman, 2001). Miner and colleagues (2001) further clarify how simple heuristics guide improvisation in the product development context. This tension is particularly pertinent for strategy in dynamic markets where change is not only common, but also critical for performance (Teece, Pisano, and Shuen, 1997). For instance, Mintzberg and McHugh (1985) note how a balance between more structured “deliberate strategy” and less structured “emergent strategy” enable innovative and yet ultimately coherent performance in turbulent landscapes (e.g., of Yahoo able to adapt due to its simple rules - Rindova and Kotha, 2001).

Despite this wide recognition of the tension-dilemma of too much versus too little structure, a number of issues remain (e.g. when is it too much) thus still unable to ascertain the underlying theoretical logic that links the tension between too much and



too little structure, environment, and performance. The following ideas will hopefully shed some light on this topic.

Structure can be defined as any specific and regular pattern of organisation such as roles, linkages, and rules (Lawrence and Lorsch, 1967; Galbraith, 1974; Scott, 2003).

The range of optimal structures varies inversely with unpredictability (in unpredictable environments, there are very narrow ranges of optimal structures with catastrophic drops on either side that is likely to be punishing to manage. Additionally, other important aspects of market dynamism such as velocity, complexity, and ambiguity, have their own effects on performance.

This dynamic interplay suggests an adaptive view of organisations and strategies, importantly it suggests complexity logic to aid in explaining adaptation in the context of the trade-offs between flexibility and efficiency in dynamic environments.

The structure challenge highlighted appear across a few organisational studies (Amabile, 1996); group problem solving (Bigley and Roberts, 2001; Okhuysen and Eisenhardt, 2002), organisational transformation (Tripsas, 1997; Galunic and Eisenhardt, 2001). Business units, for example, can autonomously experiment and adapt to their environment (Tripsas, 1997; Schilling and Steensma, 2001; Gilbert, 2005) and shield other units from the turbulence experienced (Cameron, Kim, and Whetten, 1987; Krackhardt, 1992; Tushman and O'Reilly, 1996). Collectively, this research demonstrates how structure influences organisational outcomes (Weick, 1993; Eisenhardt and Tabrizi, 1995; Hatch, 1998; Weick, 1998; Miner, et al., 2001).

This research indicates that starting with too much structure work adversely in terms of innovative outcomes, conversely, however the problem of having too little organizing structure can be dangerous Weick's (1993). From a network research viewpoint, it seems to suggest that an organisation's network of relationships creates unique structural constraints and opportunities, which in turn profoundly effect organizational outcomes (Galaskiewicz, 1985; Powell, 1990; Fligstein, 2001). Computational studies find that these networks are easily searchable and tolerant to high degrees of connectivity error because of built-in redundant connections (Albert, Jeong, and Barabasi, 2000; Watts, Dodds, and Newman, 2002). Taken together, research in network sociology illustrates that moderately structured networks produce superior outcomes for both organisations and networks.

Studies of strategy in dynamic markets (Mintzberg and Waters, 1982; Mintzberg and McHugh, 1985; Burgelman 1994), are also concerned with the effects of structure on performance, with early work focusing on the importance of the balance between "deliberate strategies" (top-down, coherent, and organised), versus "emergent strategy" (arising spontaneously, bottom-up, and less structured).

Similarly, Burgelman (1996) describes the simple-rules strategy at Intel (e.g., adherence to the rule allowed Intel to shift from DRAMs to microprocessors without the explicit intervention of the firm's senior executives). Rindova and Kotha (2001) reveals how Yahoo! managers used three partnership rules to help capture new opportunities in the emergent Internet industry (e.g., basic service or product must be free; do a deal only if it enhances the customer experience; and make no exclusive deals. These three modest rules provided coherence and direction about the alliance process, yet did not prescribe the types of alliances that needed to be formed, allowing managers flexibility to pursue a variety of partnerships depending on the opportunities, migrating the company from a search engine to interactive services such as auctions and e-commerce.



These case studies indicate moderate structure to be associated with high performance. Thus, an emerging perspective on strategy in dynamic markets suggests that, as markets become more dynamic, success is likely from loose capabilities that remain purposefully simple (Eisenhardt and Martin, 2000).

Complexity theory seeks to understand how system level adaptation to the environment emerges from the actions of its agents (Anderson, 1999; Eisenhardt and Bhatia, 2002). A counter-intuitive feature of complexity theory is that systems composed of a few simple structures give rise to adaptive behavior (Prigogine and Stengers, 1984; Reynolds, 1987; Kauffman, 1989; Langton, 1992). By condensing learning about the environment into simple structures (simple rules or schemata) such systems create a balance of order and disorder, enabling adaptation (Holland, 1992; Gell-Mann, 1994). Kauffman (1993) notes, systems exhibiting such behaviors, often called complex adaptive systems (CAS).

Several features of complex adaptive systems are particularly useful in understanding the tension between too much and too little structure, i.e., the adoption of simple rules or schemata for effective adaptation. An example is Reynolds (1987) computer simulation, highlighting systems composed of very simple rules could produce the adaptive flocking behavior that is observed in bird migration (rules were simple in that the number of rules was small – i.e., only 3 rules to produce the behavior; each rule guided only a few, direct actions such as, if too close to another bird, then the bird should move away by a fixed amount).

## Conclusion

In key literature, it seems that a moderate amount of structure leads to higher performance (Kauffman, 1993; Gell-Mann, 1994). The logic that underlies these observations and are consistent with research in organisation studies, network sociology, strategy, and complexity theory, suggest over-structured systems constrain behavior by impeding improvisational response to dynamic environments (Weick, 1976; Reynolds, 1987; Langton, 1992; Kauffman, 1993), while systems that are understructured lack the coherence to efficiently respond to changes in these environments (Brown and Eisenhardt, 1998; Weick, 1998). This points to the existence of an optimal level of organisational structure. Simpler structures are useful because they are applicable to a broad array of opportunities (Brown and Eisenhardt, 1998; Rowley et al., 2000), and enable improvised actions for capturing opportunity (Miner, et al, 2001; Rindova and Kotha, 2001). Conversely, as environmental dynamism decreases, more structure becomes more effective (Miller and Shamsie, 1996). In these settings, managers can have complicated or dense structures because change takes place infrequently and often incrementally (Tushman and Anderson, 1986; Miller and Shamsie, 1996; Siggelkow, 2001).

The environment as a dynamic flow of opportunities are characterised by key dimensions of, velocity, complexity, ambiguity, and unpredictability ((D'Aveni, 1994; Grant, 1996; Eisenhardt and Tabrizi, 1995; Rindova and Kotha, 2001). Where:

- **Velocity** = rapidity of information or opportunity flow (e.g., Hickson, et al., 1986; Eisenhardt, 1989; Eisenhardt and Tabrizi, 1995).
- **Complexity** = degree of features that must be successfully executed such as institutional norms (DiMaggio and Powell, 1983; Dill, 1958; Tyre and Orlikowski, 1993).



- **Unpredictability** = the degree of dissimilarity of opportunities (Dess and Beard, 1984; Baum and Wally, 1999).
- **Ambiguity** = the degree of difficulty to interpret opportunity, thus being equivocal, and difficult to perceive (March and Olsen, 1976; Hickson, et al., 1986; Santos and Eisenhardt, 2006).

Organisational rules can be perceived as structure, e.g., the modeling of organisational rules for capturing opportunities. Eisenhardt and Sull (2001), propose five types of rules: boundary, priority, how-to, timing, and exit rules. These rule types also appear in empirical research (Bingham and Eisenhardt, 2005), and also appear in the literature on dynamic environments (Burgelman, 1994; 1996; Gersick, 1994; Galunic and Eisenhardt, 1996; Brown and Eisenhardt, 1997; Rindova and Kotha, 2001; Miner et al, 2001). Each rule informs what actions are taken with respect to opportunities, e.g. which opportunities are chosen (boundary rules); in what order (priority rules); implementation or execution (how-to rules); number opportunities to tackle at a time (timing rules); when to halt (exit rules). This is likened to having a framework of rules, wherein which efficient and flexible action occurs (Weick, 1998).

### **Making the rules work**

Boundary rules informs leaders which opportunities to pursue, thus defining the scope of opportunities within which firms operate (Santos and Eisenhardt, 2005). March & Simon (1958) cites pharmaceutical companies using such rules for drug development opportunities, often even framed as in/then statements e.g., “If the drug development opportunity is (1) within cardiology, and (2) has at least a \$90 million/year projected market, and (3) for which at least one senior scientist has related experience, then consider the opportunity.”

An example of a priority rule is Intel’s rule for allocating manufacturing capacity weighed against their semiconductor products (opportunities), according to profit margins (Burgelman, 1996).

How-to rules specify the actions for executing the opportunities, and are most visible in a variety of opportunities embedded in areas such as manufacturing, sales, mergers and acquisitions. Effective operationalisation of how-to rules (i.e., heuristics specify actions for executing opportunities), captures the idea that certain actions are specified by the rules, whilst others are left open to real-time improvisation (Brown and Eisenhardt, 1997; Miner, et al., 2001). Timing rules inform the number of opportunities a firm can attend to at any Point, and are found in several studies of organisational processes in dynamic Environments, e.g., Brown and Eisenhardt (1997) found managers use timing rules to pace the execution of multiple product development opportunities according to a temporal rhythm, such as say, 1 new product every 9 months. Similarly, Gersick (1994) finds that entrepreneurs use timing rules to delimit the opportunities that are simultaneously addressed.

Exit rules indicate when to stop the execution of an opportunity (e.g., halting or eliminating fading opportunities early on, is critical for firms since it frees up resources for capturing new opportunities (Burgelman, 1994).



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