Moving far from far-from-equilibrium: Opportunity tension as the catalyst of emergence*

Benyamin B. Lichtenstein, Benyamin Lichtenstein


Abstract

Complexity scholars have identified two distinct catalysts of emergence: (1) Far-from-equilibrium dynamics that trigger order creation, and (2) adaptive tension (McKelvey, 2004) which can push a system toward instability, leading to the emergence of new order. Each of these provides a necessary but incomplete explanation of the catalyst for emergent order. In particular, the far-from-equilibrium framework, when taken to its logical ends, would conclude that most dynamic and fluid organizations are the ones farthest-from-thermodynamic equilibrium—like Exxon or GM, for example. Adaptive tension on the other hand identifies an exogenous force of market change, but doesn’t explain how emergence is actually triggered. As a solution I propose “Opportunity Tension,” which integrates the endogenous intention of an entrepreneur to create a new venture to the exogenous changes that open up an entrepreneurial opportunity—a market that will exchange money for the value being created. Opportunity tension occurs in “pulses,” each cycle leading to a new dynamic state of the system. This model, which is consonant with the notion of “dynamic creation” (Chiles et al., 2010), contributes to a complexity science that is moves us beyond a far-from-equilibrium framework.

Introduction

In our search for the driver of order creation, management scholars have developed two contrasting catalysts of emergent order: far-from-equilibrium dynamics (e.g., Meyer et al., 2005), and adaptive tension (e.g., McKelvey, 2004). Although on the surface these two approaches seem similar, technically the constructs are different in significant ways, which have important implications for an organization science of complexity.

The more common approach for describing the origin of new order is through the onset of “far-from-equilibrium” dynamics. Far-from-equilibrium approaches “elucidate the non-linear mechanisms that actually drive [discontinuous] change forward” (Meyer et al., 2005: 470a). In this theoretical framework, organizing far-from-equilibrium is what leads to “...emergence and ongoing, perpetual novelty” (Meyer et al., 2005: 450b). Choi, Dooley and Rungtusanatham (2001: 356) also use this framework to explain the origin of systemic state change, arguing that such change is triggered “when the system is far from equilibrium.” In a similar way, Browning, Beyer & Shetler (1995) show that the emergence of an alliance was sparked by “...a period of disequilibrium [which required the semiconductor industry] to operate qualitatively differently than in the past.” In sum, a range of authors focus on how far-from-equilibrium processes catalyze the emergence process.

On the other hand, McKelvey has offered a different explanation for the driver of emergence, namely adaptive tension. In McKelvey’s understanding of Prigogine’s dissipative structures theory (Nicolis & Prigogine, 1989), order creation is caused by and initiated through “energy differentials” which are imposed onto the system. New order is created when one of these energy differentials crosses a threshold (McKelvey, 2004: 319): “...[when] an imposing energy differential, what I term adaptive tension, exceeds the lower bound of the region of emergent complexity.” Plowman and her colleagues build on McKelvey’s formulation, suggesting that periods of organizational instability are often “...full of adaptive tension and tension gradients; it is in this state that emergent self-organization and creative destruction occur” (Plowman et al., 2007: 520). In these models, adaptive tension is the push, the catalyst, the driver that initiates a dynamic state that leads to emergence and order creation.

In sum, we have a bit of a conflict around causality: What actually initiates the emergence of new order? In the far-from-equilibrium approach, the entire system moves into a regime that is away from equilibrium; this “far-from-equilibrium” organizing leads to non-linearities and perturbations or experiments that generate novelty. Under continuing far-from-equilibrium conditions, new order will emerge. This is represented in Figure 1 below.

In contrast, the Adaptive Tension model suggests that the onset and increase of adaptive tension will push the system far away from equilibrium. At a threshold this process may generate a new state of emergent order. This process is represented in Figure 2 below.

On the surface one could say that this apparent conflict is not a real problem, only an issue of semantics. Furthermore, both of these constructs can be traced to the original applications of dissipative structures theory into management, sociology, and social evolution, starting with Jantsch (1980) and including important editions by Ulrich & Probst (1984) and Weber, Depew, &
Smith (1990). Further, according to one study (Lichtenstein & Plowman, 2009) these two constructs can mean essentially the same thing. So, in what ways is this a conflict, and how is that a problem?

For those of us seeking a general theory of emergence, the problem is in identifying the catalyst of order creation—what is the driver that initiates an emergence process? Although far-from-equilibrium conditions are central to this problem, it’s unclear whether those conditions initiate the process or mediate the process leading to emergence. As a means of unraveling this distinction, I take a deeper look into the functional meaning of far-from-equilibrium conditions in economic organizations. This exploration will set the stage for a third choice, a catalyst that integrates both of the other views.

The Far-From-Equilibrium View of Organization

What Is Life?—A Thermodynamic Explanation

One of the earliest explications of the far-from-equilibrium view of organization was developed by Erwin Schrödinger (1944) in his remarkable book, *What is Life?* Following his significant contributions to quantum mechanics in the 1920s and 1930s, this book presents an integrated theory about how the biological world operates—
Adaptive Tension

Fig. 2: Adaptive Tension as the Driver of Order Emergence

from the bottom all the way up. Essentially his task is to explain how atoms organize themselves into human beings; in so doing he presents a thermodynamic explanation for the way that all living matter is maintained, i.e., through the importation of what he called "negative entropy." The book explains how this order-creating process operates at each level of analysis, i.e., in atoms, molecules, macro-molecules, and so on. Finally he reaches the level of an organism, where he posits an explanation for how order gets maintained in larger organisms (Schrödinger, 1944: 73; sic):

Thus the device by which an organism maintains itself stationary at a fairly high level of orderliness (= fairly low level of entropy) really consists in continually sucking orderliness from its environment.

What does it mean to "suck orderliness" from its environment? Essentially he's suggesting that "order" is a compact form of energy; for an organism to maintain itself, it needs to import high degrees of energy into itself. This insight became the core of open systems thinking (Katz & Kahn, 1966; Thompson, 1968) and general systems thinking (von Bertalanffy, 1956; Miller, 1978); it also provides a theoretical framework for autopoiesis and similar models (Maturana & Varela, 1980; Drazin & Sandelands, 1992). Moreover, the empirical details of Schrödinger's idea—that systemic order is only maintained through a constant, far-from-equilibrium influx of energy from the environment—were worked out by Prigogine and his associates as the theory of dissipative structures (Prigogine & Glansdorff, 1971; Nicolis & Prigogine, 1989). Their approach was nicely summarized by Maguire and McKevey (1999: 29), and it forms the starting point for McKevey's long-time exploration of complexity in management:

The key question becomes: What keeps emergent structures in states of equilibrium far above entropy, that is, in states that violate, locally, the 2nd law? Prigogine & Stengers (1984) observe that energy importing, self-organizing, open systems create structures that in the first instance increase neg-entropy...[These structures] are labeled “dissipative structures,” because they are the sites where imported energy is dissipated.

By this formulation, the more entropy that is dissipated, the more order is created, through a web of nested and coevolving
Emergence: Complexity and Organization

Far-, Farther-, and Farthest-Away-From-Equilibrium

To draw out the metaphor in economic terms, consider the analogy of the firm as an “energy conversion system” (Slevin & Covin, 1997) of inputs, transformations, and outputs (Scott, 1981). In the most simple example these inputs are essentially its revenues, cash flows and core resources; internal transformations represent the business functions and entrepreneurial activities that produce value for customers (Afuah, 2004), and the outputs are the goods or services being offered by the organization. In exchange for the value customers receive through these goods or services they purchase these offerings using money, which in this analogy represents a highly compact form of energy—a generalizable medium of exchange. In sum firms “convert” potential pools of resources, i.e., a potential market, into revenue, by creating products or services which serve this market; the money which customers exchange for the value they receive is the energy that literally sustains the firm.

In its simplicity (by removing the many complexities that would be required to explain most interesting organizations) this example offers a thermodynamic response to the question of how organizations operate in “far-from-equilibrium” conditions. We begin with the definition of equilibrium in thermodynamic terms: equilibrium represents the absence of potential, the eradication of difference, the complete cessation of all activity (Adams, 1988; Dyke, 1988; Odum, 1988; Swanson, 1989, 1992). “Economic equilibrium, therefore, constitutes a point of rest from which there is no endogenous tendency for any individual, form, or market to change” (Meyer et al., 2005: 459). In contrast, as soon as an entrepreneur engages in value-creation activities which are enjoyed by customers who exchange the value they receive for money, the ‘system’ moves away from equilibrium and toward a non-equilibrium dynamic. If the market need and the venture offerings are sustainable, the entrepreneurial firm can exist in a dis-equilibrium dynamic state for quite some time. From this logic, the higher the exchanges between the firm and the environment—in terms of resources, including cash flow or revenue—the farther away the firm is from its zero-activity equilibrium point.

The implications for this thermodynamic framework are significant. At one end of the spectrum consider the classic mom and pop grocery store, or small manufacturing firm. These organizations exemplify a simple business model design (Zott & Amit, 2007) that generates a dynamically stable organization, in which net revenues from sales, i.e., operating revenues with Cost of Goods Sold subtracted, are sufficient to pay for Fixed Costs including employee and executive salaries. “Lifestyle ventures” like these are organized primarily to create a stable lifestyle for the lead entrepreneur(s) and those they employ. From this view, all companies operate in some degree of non-equilibrium conditions (Dyke, 1988; Robb, 1990). We can, for example, define the “distance from equilibrium” of a firm as its overall cash flow, revenues (or some other financial ratio), such that the more of these revenues flowing through the firm, the farther-away-from-equilibrium the firm would be operating.

Pushing the metaphor further, some ventures identify larger pools of economic potential, i.e., larger markets (Bhide, 2000) and more valuable technologies or business models; clever entrepreneurs find new ways to capitalize on these potentials by creating and accessing the resources necessary to produce value in a sustainable way (Stevenson & Gumpert, 1985). The more resources and the more value that can be produced—assuming there is a sufficiently large market that will purchase the offering—the farther away from equilibrium the firm will be operating. Thus, a small manufacturing firm will be a moderate distance away from thermodynamic equilibrium, a large company will be much farther away, and huge multi-national corporations are the farthest-away-from equilibrium. By this reasoning, the farthest-from-equilibrium firms in the world—measured by net revenues—would be Walmart, GM and Exxon/Mobile—the latter earned $40.6 Billion dollars in net profit in 2007, with more than $400,000,000,000 in revenues.

However, this scientific analysis runs counter to the common management metaphors associated with “far-from-equilibrium” conditions; including “…the constructive role of disorder and even crisis in organizations, as well as the merits of management relinquishing and distributing control to a more autonomous work-force” (Maguire et al., 2006: 173). Far-from-equilibrium conditions that managers face are neither predictable nor linear, instead they lead to “ongoing, perpetual novelty” (Meyer et al., 2005: 470).

In contrast, Exxon and GM seem to exemplify the opposite: Firms that abide by a model of General Linear Reality (Abbott, 1988), with managers who lead by control, under the assumption Gaussian averages rather than Paretian extremes (Andriani & McKelvey, 2009). The recent “Great Recession” has shown, if nothing else, the inaccuracy of these assumptions, highlighting the dis-equilibrium nature of our social world.

Creating Emergence?

To review: The goal of this essay is to highlight a contradiction in how we as complexity researchers explain what catalyzes emergence. I started by identifying the two versions of those explanations: far-from-equilibrium dynamics, versus adaptive tension (Figures 1 and 2, above). Then I reviewed the underlying assumptions of far-from-equilibrium dynamics, by presenting a simplified version of the firm as an “energy conversion system.” In this economic analogy to a thermodynamic system, distance...
from equilibrium technically refers to the degree of energy flowing through the system, measured by the amount of revenues (or cash flow) in the firm. Extending this metaphor to its logical ends shows that the farthest-from-equilibrium companies are those with the highest revenue streams.

However—and this is the core of my argument—these firms don’t exemplify the novelty, flexibility, and adaptability that could catalyze emergent order. In other words, huge companies like GM, Exxon/Mobile, and WalMart—far-from-equilibrium though they may be—do not appear to embody the conditions that initiate the creation of new order. Rather, when we say "far-from-equilibrium" we seem to imply something quite different from its technical meaning, something much more dynamic, creative, innovative, and nonlinear. But these meanings are imputed as metaphors, they are not embedded within a rigorous analogy to the thermodynamic science.

On the other side, McKelvey’s “adaptive tension” presents a useful but also incomplete view of how emergence is catalyzed. Adaptive tension is caused by external situations, whether a market-based performance gap or an external directive to change course. Specifically, McKelvey (2004: 319) defines adaptive tension as “an imposing energy differential” that can spark a phase transition; this differential reflects an “externally influenced” change to the “control parameters” of the system.

However as any entrepreneur knows, the creation of new business venture is almost never sparked by external influences alone. Organizational emergence requires significant initiative and entrepreneurial action (Gartner, 1993). Even the most basic view of opportunity recognition requires an entrepreneur who is alert to external changes (Kirzner, 1997), and who takes risks that reflect his/her experience, expertise, and access to resources (Ardichvili, Cardozo & Ray, 2003).

To be clear: adaptive tension represents a crucial aspect of emergence, namely exogenous market changes that lead to new (and newly perceived) pools of potential resources. Far-from-equilibrium conditions, on the other hand, represent an endogenous source of variation and change, which also plays a crucial role in catalyzing emergence. Both elements are important, but neither one alone is sufficient to initiate the process of order creation. Formally, neither far-from-equilibrium conditions nor adaptive tension on their own may be sufficient to catalyze emergence. Can these two constructs be integrated in some way, offering a more dynamic view that incorporates the endogenous and exogenous elements of emergence?

“Opportunity Tension” as a Catalyst of Emergent Order

As an alternative catalyst I propose the notion of “Opportunity Tension.” Opportunity tension represents an internal drive—the entrepreneur’s intention—that arises in conjunction with his/her perception of a business opportunity—a market need that can be filled through entrepreneurial action. Opportunity tension starts when an entrepreneur perceives/identifies a pool of potential resources, creating an opportunity and simultaneously constructing a way to capitalize on that economic potential through a unique and sustainable business model (Zott & Amit, 2007). In opportunity tension, the endogenous drive to create a new venture is bound up with the exogenous changes that are revealed through the creation of a market opportunity.

Creating and enacting an opportunity takes a huge amount of time and effort, a great deal of intention and action. Empirical evidence shows that the greater this drive to action, the more likely that a business will actually emerge as an independent start-up venture (Lichtenstein et al., 2007). An entrepreneurial pursuit of an opportunity requires a high degree of personal commitment as well as a degree of personal passion (Adler & Obstfeld, 2007); these reflect the “creative tension” within the entrepreneur (Fritz, 1984; Senge, 2006) that motivates the process of capitalizing on the opportunity. At the same time, this intention—a commitment to pursue the venture—is based on the perception of a market potential, an entrepreneurial opportunity to create new value for customers who want it. If I feel I can really do this, the opportunity becomes alive, initiating a creative tension within. When there is opportunity and (in)tenstion, the organizing process begins (Lichtenstein et al., 2007).

In this way, the core of opportunity tension integrates the combination of internal and external motivation. “Energy differentials need to have a motivational valance attached before they can be expected to be felt as tension by agents” (McKelvey, 2001: 195). This motivational valence is opportunity tension: the felt belief that the emerging opportunity is worthy of pursuing. More formally opportunity tension describes the combination of externally imposed changes leading to exogenous energy differentials and pools of potential resources, with internally motivated action leading to the entrepreneurial activities that organize a business (Gartner & Brush, 2007). Thus, the intrinsic motivation to pursue the idea is supported by the extrinsic motivation of the potential market for the idea. At the same time, this extrinsic recognition of a market opportunity feeds back to increase intrinsic motivation, since the size and viability of the perceived market provides a measure of confidence that supports the intrinsic drive for organizing. As a whole, opportunity tension provides the catalyst for order creation.

Opportunity Tension is Rare

Although novelty and improvements are happening all the time, the actual initiation of opportunity tension is not a common activity. Only a unique or unusual event (Andriani & McKelvey, 2007) would have the power to push an entrepreneur or an organization beyond its structural inertia, to start a process of novel organizing and emergent order creation. McKelvey (2001) shows this in his exemplar of adaptive tension: Jack Welch, as the CEO of GE, catalyzed adaptive tension in every business there by giving them only one success metric: “Be #1 or #2 in your industry, or be reorganized, split up, or sold.” This charge is
not an “average” or “normal” event—it is extreme, perhaps one of the most extreme challenges ever given to a group of companies. And the result, conditioned by Welch’s remarkable leadership, was also extreme, as GE became one of the most financially successful corporations in the past 100 years.

This kind of extreme event is driven by opportunity tension: Welch as entrepreneur creates an internal tension in each of his divisional executives by using an external ‘bar’ that sparks a new kind of thinking—an entrepreneurial, opportunity-driven mindset (Lumpkin & Lichtenstein, 2005) through which these executive managers identify, create and act on new business opportunities. As Gartner (1993; Gartner et al., 1992) shows, organizational emergence often starts in the same way: in rare moments of tension an individual sees an opportunity for change, and at the same time feels the internal drive to act on that opportunity. Such unique experiences, along with the commitment and follow-up they catalyze, are often at the origin of opportunity tension.

Cycles of Opportunity Tension

This urgency, this push, does not last forever; the internal tension that drives action does not exist indefinitely at that initial very high rate. Instead, a flush of creative energy and hard work that can last for a period of weeks or months ultimately settles down into a more sustainable degree of intensity. Thus, opportunity tension occurs in ebbs and flows, just exactly like creative tension (Fritz, 1989). Specifically the energy of creative tension, which is at the heart of opportunity tension, is generated through a polarization—the ‘distance’ between one’s envisioned goal and one’s present state: The farther from the goal, the higher the creative tension to achieve it (Senge, 2006). Once the goal has been achieved, creative tension is reduced.

Like the source of creative tension in artists, opportunity tension motivates action for an intense period of time, sometimes generating a kind of “flow” state (Csikszentmihalyi, 1990). Within this flow state, organizing continues until the initial goal is achieved (Lichtenstein et al, 2007); sometimes the goal itself changes through the organizing process (Lichtenstein, Dooley, & Lumpkin, 2006; Sarasvathy, 2001). Yet once reached, even for short period of time, the degree of intensity is relieved.

Opportunity tension is thus a pulse of activity—a committed intention to pursue this project and generate an emergent result. The project can be the creation of a new business, the re-creation of an existing company, or a much more contained initiative that extends some quality of the organization. Given the right set of resources and conditions new order may come into being; this emergent order literally converts the environmental (market) potential into real value for customers who pay for that value using resources (e.g., money) that keeps the organizational operating.

As others have pointed out, this process of emergence is often expressed as a “state change” within an organization (Cheng & Van de Ven, 1996; Dooley, 1997) as the firm or company move from one “dynamic state” to another (Levie & Lichtenstein, in press). For example, Plowman and her colleagues show how Mission Church transformed from a “silk-and-stockings” congregation in one era, to a social activist community in a new era that worked tirelessly to improve conditions in its inner-city neighborhood. Chiles and his colleagues show how the emergence of Branson, MO occurred in a series of “epochs,” each era of change representing a transformative shift from one set of disequilibrium conditions to another. In a similar fashion Lichtenstein, Dooley & Lumpkin’s (2006) analysis of one start-up venture identified an “emergence event”—a punctuated shift in strategy and tactics that reflected a new goal and vision for the company, and the entrepreneurial pursuit of a new opportunity.

In each of these cases, entrepreneurial action forms around one opportunity; this may be followed by another opportunity, and so on; each of these initiates a new cycle of opportunity tension. Each of these cycles represents a distinct phase of activity, initiated by the combination of exogenous forces of change and endogenous forces of creative expression, resulting in new products and offerings that yields more novelty in the market, attracting more customers (additional revenue streams) and maintaining the organization at this next dynamic state (Levie & Lichtenstein, in press). Entrepreneurial leaders are always on the lookout for new opportunities, each of which may catapult the organization to yet another new dynamic state.

Chiles and his colleagues (Chiles et al, 2010a, 2010b) have explored this cyclic process deeply, providing a powerful framework for understanding the dynamics of markets in continual disequilibrium. In their view, any given “round” of competition—each cycle of opportunity tension—may be followed by another round or cycle of emergent change:

Craig (1996: 305) characterizes these phases as ‘rounds’ of hypercompetition...[each of which is] “followed...by a subsequent hypercompetitive ‘round,’ equally intense but based on different competitive dimensions.” ...Such phases of hypercompetition may be understood in the context of continual disequilibrium as examples of “punctuated disequilibrium,” in which kaleidic shifts further disrupt markets already in disequilibrium, driving them...from one disequilibrium phase to another (Chiles et al., 2010b: 21).

Moving Far From Far-From-Equilibrium:

Emergence: Complexity and Organization 6
From an entrepreneurial perspective, value creation is the goal of opportunity tension: When an entrepreneur or any leader
must expend energy (time, money, etc.) to produce it, the venture or initiative will cease to exist (unless it is maintained by some other source).

Entity can be traced to the value which it creates; when the perceived value of the offering is less than what it ‘costs’ (in energy, albeit to a lesser degree than the publisher would like, I am sure.!). In this way, I posit that the sustained emergence of any
practitioners; that value is paid for through subscriptions which sustain the activities required to produce and publish the journal
this extension, the emergence of
This implication extends much further than organization creation. This paper emerged because of the value that I perceived it
This implication extends much further than organization creation. This paper emerged because of the value that I perceived it
Sustainability and Value Creation
Further—and this is a very important distinction—unique opportunity tension events are viable only if there is a potential pool of
resources that the entrepreneur believes s/he can capture through this new round of organizing. That's because in order to
maintain a newly expanded system, a higher amount of "negative" entropy is needed, i.e., a system farther-from-equilibrium
requires more net resources to maintain itself in its new expanded state (Levie & Lichtenstein, in press). In ecological terms, dynamic creation is only viable to the degree that it is sustainable, for new order can only be created and maintained through the transformation of energy that exists in some form. For a time entrepreneurs can draw on the energy of personal passion,
social connection and shared vision, but as any leader knows even these have some limit. These limits are far more visible
when the resources needed to create value are more physical, as in any company that makes and sells tangible objects. The
current levels of environmental degradation around the world show the severe limitations to a belief in unlimited material growth.
For these reasons, dynamic creation must be bound up with an economics and a systems science of sustainability.

A second implication, less severe but more broad, is that all organizing must generate value of some kind if it is to survive for
any length of time. In formal terms, emergent order is always based on value creation, because continuing to produce that
value—whether social or economic—requires a consistent input of energy that maintains the system in a sustainable way.
We’ve already seen the business examples: A firm that produces value through the ‘widget’ it creates is maintained by the
revenues it receives from the customers who pay for the widget in exchange for the value it provides them.

This implication extends much further than organization creation. This paper emerged because of the value that I perceived it
would create for my readers and for me; that perceived value has sustained me through the writing and revision process. By
extension, the emergence of Emergence: Complexity & Organization is based on the value that it provides for scholars and
practitioners; that value is paid for through subscriptions which sustain the activities required to produce and publish the journal
(albeit to a lesser degree than the publisher would like, I am sure.!). In this way, I posit that the sustained emergence of any
entity can be traced to the value which it creates; when the perceived value of the offering is less than what it ‘costs’ (in energy,
time, money, etc.) to produce it, the venture or initiative will cease to exist (unless it is maintained by some other source).

Implications and Conclusion

Summary
From an entrepreneurial perspective, value creation is the goal of opportunity tension: When an entrepreneur or any leader
perceives an opportunity, what they see/create is a new means for generating value for others; the creative tension inherent in
this vision leads to a cycle of entrepreneurial organizing that is aimed at capitalizing on the opportunity. Emergence—whether of
a project, an initiative, or a company—is catalyzed by opportunity tension. Opportunity tension thus integrates the endogenous
commitment of an entrepreneur with the exogenous market changes that lead to her/his perception and creation of a business opportunity. The result is the emergence of a product/service that adds heterogeneity to the market, pushing the economic region further and further from equilibrium (Chiles et al., 2010a).

As a whole, the (opportunity tension \rightarrow emergence) process exemplifies the core of dynamic creation. When grounded in social and environmental sustainability a dynamic creation approach can explain the emergence and development of human societies (Carniero, 1970, 1987), of cities (Dyke, 1988), and of expanding order in society (Adams, 1988; Coren, 1998). Dynamic creation, driven by cycles of opportunity tension, offers a view of emergence that begins to move us far from far-from-equilibrium, and toward a more powerful science of complexity for management.

Notes

*This paper was originally presented at the Organization Science Winter Conference, 2007. The author wishes to thank Bill McKelvey, Kevin Dooley, Todd Chiles, and many other complexity colleagues. In addition, I am indebted to Kurt Richardson, and my reviewers who offered excellent advice that improved the paper.

1. This wise distinction was presented by one of my

References


