

**Responses to Climate Change: An Integrative Model of Organisational Processes using a  
Complex Evolving Systems (CESs) perspective**

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## Abstract

This paper explores how business organisations can develop effective responses to the far-from equilibrium conditions in their environment, intensified due to climate change. The disruptions caused by climate change and the regulatory regime created in response to it, have exacerbated far-from equilibrium conditions in the business environment. Traditional studies have relied on linear assumptions to study organisations. Given the different nature of far-from-equilibrium conditions such as instability and unpredictability, these assumptions should be replaced by an understanding of organisations as complex evolving systems (CESs). Since CESs are able to meet the challenges of far-from equilibrium conditions, conceptualising organisations as CESs and understanding their underlying processes can help in developing effective responses to climate change. By reviewing current literature we present an integrative model of underlying processes in CESs which enable them to respond to far-from equilibrium conditions. This model is then applied to propose hypotheses for developing effective organisational responses to climate change.

*Keywords:* far-from equilibrium, complex evolving systems, climate change, organisational process

**Responses to Climate Change: An Integrative Model of Organisational Processes using a  
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This conceptual paper presents hypotheses for improving the effectiveness of organisational climate change responses to meet the challenges of the intensified far-from equilibrium state in their environment. A complex evolving systems (CESs) perspective of organisations is adopted to study organisational climate change responses.

Current perspectives for study of organisations are driven by a model of general linear reality (Abbott, 1988) and the ‘machine’ metaphor of organisations (Morgan, 2006). As a consequence academic thought has focused primarily on explaining organisational behaviours, processes and outcomes at equilibrium (Chiles, Vultee, Gupta, Greening, & Tuggle, 2010; Haveman, Russo, & Meyer, 2001; Zammuto & Cameron, 1985). The ensuing organisational theories such as neo-classical economics, Kirznerian economics, and Schumpeterian economics are characterized by tacit assumptions of linear relationship between cause and effect, stability, determinant nature of outcomes and ignorance of discontinuities (McMullen & Shepherd, 2006; Meyer, Gaba, & Colwell, 2005). Due to these pervasive beliefs in stability and equilibrium, linear models attempt to explain even far-from equilibrium outcomes in terms of protecting equilibrium assumptions (Lichtenstein, 2000, 2009; Shane & Venkataraman, 2000).

Climate change has exacerbated far-from equilibrium characteristics in the business environment (Linnenluecke & Griffiths, 2012; Winn, Kirchgeorg, Griffiths, Linnenluecke, & Günther, 2011). Organisational processes and outcomes in far-from equilibrium conditions are emergent and not-determinate (Chiles, Meyer, & Hench, 2004; Chiles et al., 2010). Given the inadequacy of traditional determinant linear perspectives of organisations, in explaining and

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understanding emergent organisational practices (Ormerod, 1998), we need new perspectives to study organisational climate change responses. We need to challenge the deeply held assumptions of linearity underlying existing management theories to understand the new far-from equilibrium conditions of business environment, intensified due to climate change.

In order to challenge the dominant root metaphor assumptions of 'organisations as machines' of current literature (Alvesson & Sandberg, 2011), we adopt a CESs perspective of organisations to study organisational climate change responses. A CESs approach embraces non-linearity and unpredictability, key characteristics of far-from equilibrium condition (Meyer et al., 2005). CESs are able to meet the disruptive challenges of far-from equilibrium conditions (Mitleton-Kelly, 2003). This perspective is therefore suitable for studying organisations facing disruptions due to climate change (Boulton & Mitleton-Kelly, 2010; Winn et al., 2011).

By conceptualising organisations as CESs, we can get deeper insights about underlying processes of climate change responses. This understanding of the underlying micro-level properties of organisational climate change responses will help in developing an understanding of organisations and underlying organisational processes in a far-from equilibrium state. This will enable us to identify and improve managerial practices and strategies to improve the effectiveness of organisational climate change responses.

By reviewing literature from systems thinking, complexity theory, chaos theory and organisational change, this paper presents an explanatory integrative model of underlying organisational processes in of CESs which enable them to meet the challenges of far-from equilibrium conditions. Furthermore by applying the model to organisational responses, the

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paper also proposes hypotheses about managerial practices and strategies for improving effectiveness of climate change responses.

The paper is structured in the following way. First it explains the nature and characteristics of a far-from equilibrium state and how it has been intensified by climate change. This is followed by a review of current literature which identifies gaps in research regarding the study of organisations by adopting a CESs perspective. Building on this literature an integrative model for explaining organisational processes in far-from equilibrium conditions is presented. This is followed by an application of the model to organisational responses to climate change. Key propositions are derived through a review of the current literature, followed by discussion, implications for future research and conclusion.

### **A far-from equilibrium reality intensified by climate change**

In a broader social context, a far-from equilibrium state is indicative of moving away from established norms, procedures, ways of working and relating (Mitleton-Kelly, 2003). More recently, it has been described as a state where an organisation is perturbed well away from its established norms, or away from its usual ways of working (Senge, Carstedt, & Porter, 2001). Once an organisation moves into this far-from equilibrium state, it is supported and sustained by the activities of its members (Chiles et al., 2004).

Climate change has exacerbated far-from equilibrium conditions by disrupting the natural, regulatory and business environment. The physical impacts and the ensuing changes in the regulatory environment due to climate change (Okereke, Wittneben, & Bowen, 2012) have perturbed organisations away from their established norms and ways of working (Senge et al.,

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2001). Due to this compounded instability created by direct impacts (such as physical risks) and indirect impacts (such as regulatory risks) of climate change (Enkvist, Naucler, & Oppenheim, 2008), far-from equilibrium conditions in business environment have been intensified by climate change.

Contemporary organisational practices are being disrupted due to implications of climate change (Furrer, Hamprecht, & Hoffmann, 2012; Rothenberg & Levy, 2012). In these intensified far-from equilibrium conditions, traditional business activities are being altered and new ways of organising are being developed such as new organisational capabilities (e.g. Carbon measurement and accounting) (Thistlethwaite, 2012), new organisational functions (e.g. waste recycling, teleconferencing and virtual meetings) (Haigh & Griffiths, 2012), new structures (e.g. change or relocation of infrastructure) (Linnenluecke, Stathakis, & Griffiths, 2011) and change in organisational operational processes (e.g. green manufacturing and new production processes) (Enkvist et al., 2008).

It is therefore reasonable to assume that the far-from equilibrium conditions of the current business environment have been intensified by climate change. Therefore, we need to understand organisational behaviours and processes which enable them to respond to these far-from equilibrium conditions.

### **The research lacuna**

Due to deeply held beliefs of stability and linearity, academic thought has focused primarily on explaining organisational processes and behaviours at equilibrium (Haveman et al., 2001; Meyer et al., 2005; Zammuto & Cameron, 1985). These theories are characterized by tacit

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assumptions of linear relationship between cause and effect, stability, and ignorance of discontinuities (Meyer et al., 2005). At far-from equilibrium, unpredictable behaviours and outcomes emerge in an organisation through non-linear mechanisms (Choi, Dooley, & Rungtusanatham, 2001; Meyer et al., 2005). The emergent outcomes of these behaviours introduce novelty, surprise, and instability rather than a repetitive, predictable, stabilizing force which gravitates towards equilibrium (McKelvey, 2004).

There is a dearth of organisational theories that explain the emergent outcomes at far-from equilibrium and their underlying processes (McKelvey, 2001). It is therefore proposed that theories which enhance understanding of organisational behaviours and outcomes at far-from equilibrium should be developed (Chiles et al., 2010; Winn et al., 2011). This understanding will enable organisations to address challenges of far-from equilibrium conditions.

### **An explanatory model of far-from equilibrium processes and outcomes: A CESs perspective of organisations**

Traditional theories draw from the 'machine metaphor' of organisations. However in far-from equilibrium conditions, organisations can be conceptualised as CESs. Due to the negligence of far-from equilibrium reality there is a lack of organisational theories adopting the CESs perspective of organisations. In CESs, unpredictable behaviors and outcomes emerge from the spontaneous self-organisation of connected and interdependent agents at far-from equilibrium conditions (Kauffman, 1990; Mitleton-Kelly & Papaefthimiou, 2000). These emergent outcomes are sources of novelty and make CESs resilient to far-from equilibrium conditions (Mitleton-Kelly, 2003). The underlying processes that lead to the emergence of an organisation's behaviours and outcomes are characterized by non-linear mechanisms (Andersen, 1999).

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Let us consider some examples of unpredictable outcomes emerging in a far-from equilibrium state. Branson, Missouri was an obscure town with one store and one post-office, known for its scenic beauty. Over the last century, it has established itself into a thriving centre of country music and developed into as a multi-billion dollar tourist attraction and entertainment venue. It appears that the behaviours leading to this development were spontaneous rather than planned. One of the significant outcomes of such behaviours has been the creation of live musical performance theatres in the area (Chiles et al., 2004).

In another case, accumulation of a significant financial deficit and the appointment of a new CEO in a London based NHS hospital (we will refer to it as Hospital A) created a far-from equilibrium state which spontaneously led to fundamental changes in relationships and ways of working. As expected, the hospital was able to reduce the deficit by reducing costs, however at the same time it was also able to improve the quality of service to patients by creating a clear distinction between clinical and administrative activities. Pre-existing budgetary constraints were reduced and team leaders were allotted funds to explore new ways of working. Within a year, through the emergence of self-organized cross-directorate projects, Hospital A was able to achieve financial savings as well as improve the quality of its services by reducing patient journey time (Mitleton - Kelly, 2011a).

While in the Branson example a far-from equilibrium state was created due to the increasing diversification of the community, at Hospital A the introduction of a new CEO coupled with a financial deficit perturbed the hospital's ways of working. In both cases, emergent behaviours led to unpredictable outcomes, and neither external control nor intervention was observed. In Branson there was an emergence of a collective of music theatres (Chiles et al.,



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2004) and in Hospital A there was emergence of cross-directorate projects (Mitleton - Kelly, 2011a).

It is through these emergent outcomes that CESs are able to meet create order from disorder and meet challenges of far-from equilibrium conditions. Emergent organisational behaviours and outcomes such as the ones illustrated in the above examples are not explained by current models based on linear assumptions. These cases contradict current institutional theory models, which rely on control mechanisms and planning procedures to explain organisational behaviours and outcomes. As illustrated by both cases, the underlying process of emergence of organisational outcomes at far-from equilibrium was not achieved through centralized control and top-down planning (Chiles et al., 2004). In fact, the absence of centralized control and top down planning created an enabling environment which facilitated the emergence of beneficial outcomes.

This paper proposes an explanatory model (Figure 1.) to account for underlying CESs processes in far-from equilibrium conditions. The model represents an integration of disparate insights from literature on complexity, systems, chaos and organisational change, to explain far-from equilibrium processes. The left side of the model represents the micro-level processes and patterns among organisational members, while the right side represents macro-level organisational behaviours and outcomes.

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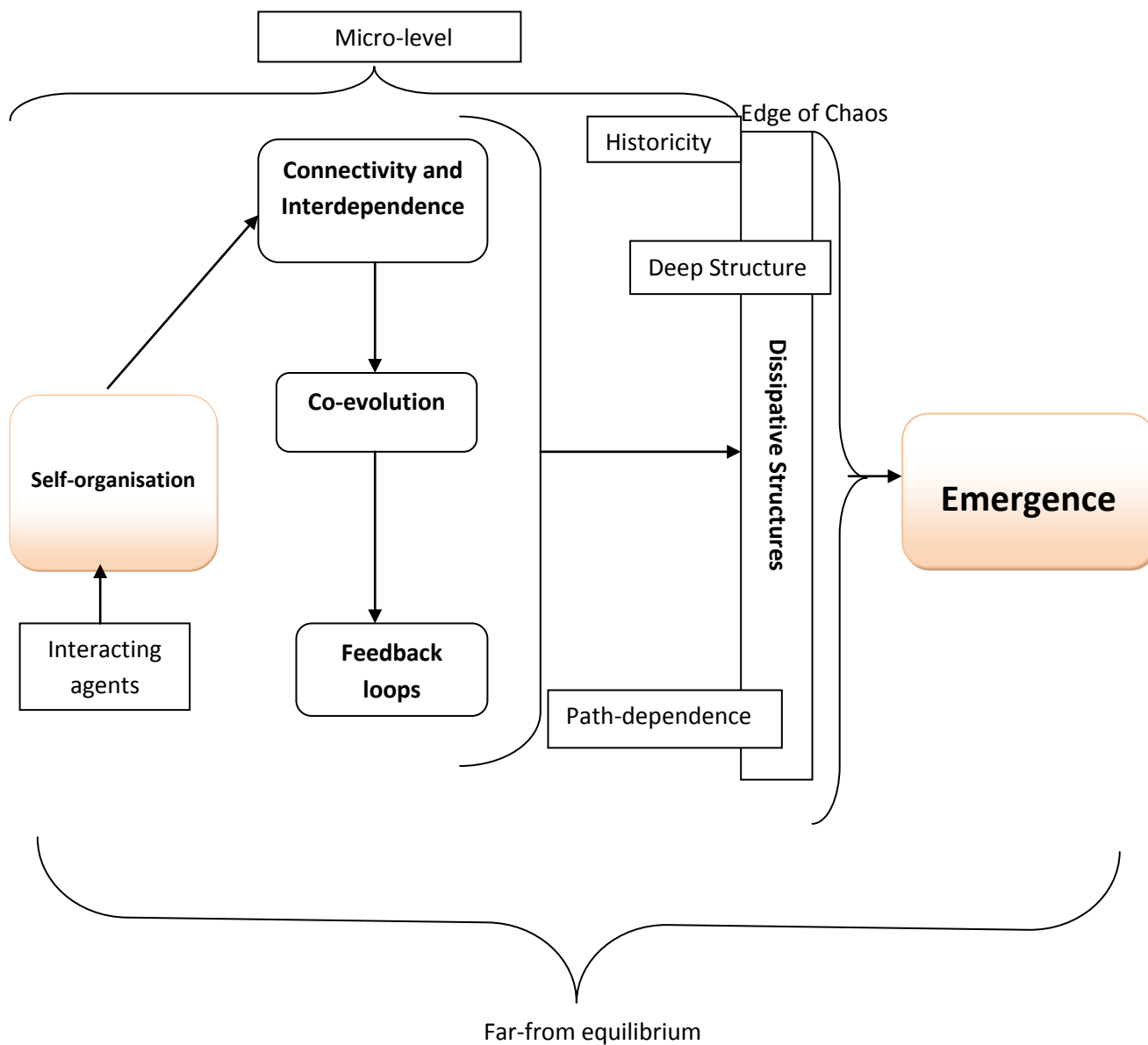


Figure 1. Organisational processes in CESs.

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The spontaneous process of self-organisation is influenced by the non-linear dynamics of co-evolution and negative and positive feedback loops. This leads to novel behaviour resulting in unpredictable emergent outcomes (Mitleton-Kelly, 2006; Richardson, 2008). When operating far-from equilibrium, organisations produce creative, innovative, continually changing patterns. Under these conditions, organisations are driven by negative and positive feedback loops to dialectical states of stability and instability, or predictability and unpredictability (Stacey, 1995). New ideas and perspectives lead to emergent unpredictable organisational outcomes (Mitleton-Kelly, 2006). This is illustrated on the extreme right hand side of Figure 1.

At the micro-level, organisations are made up of connected agents who have shared beliefs and sentiments such as loyalty (Nancy, 1990). Also, in organisations, the agents are interdependent, so that that a decision or action by one may affect related agents (Mitleton-Kelly & Puszczynski, 2004). Also the way other agents make decisions also influences the decision making process of an agent and vice-versa (Stacey, 2007). This connectivity and interdependence may be the result of formal organisational structures or procedures (e.g. a connection and interdependence is created between agents in the payroll and other departments due to organisational rules about employee compensation), or of informal interactions among the agents (e.g. people communicating during their lunch break).

These connected and interdependent agents spontaneously self-organise, without any external control or direction, at far-from equilibrium (Mitleton-Kelly, 2003; Varga et al., 2009), as depicted in the first box on the extreme left side of Figure 1. Self-organisation is the capacity of the connected and interdependent agents to generate new forms and patterns without any external imposition (Holland & Melhuish, 1999). It is the first step in the emergence of novel

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organisational behaviours and outcomes. The deep structure of the organisation that is the organisation's accumulated history, learning and logic (Chiles et al., 2004; Macintosh & Maclean, 1999) restricts self-organisation therefore creating a bounded predictability (Kemp, 2009). New structures, behaviours and patterns arise on their own, without any plan, and are not facilitated by any external control or direction (Mitleton-Kelly, 2003).

An example of self-organisation is provided in the study undertaken by Humanitarian Futures Programme at King's College London (KCL) and the Complexity Group at the London School of Economics to look at potential political, environmental and economic crises in West Africa and how the ECOWAS (Economic Community of West African States) Commission might address them. These crises call for disaster risk reduction responses by the community members. Without any external aid and expert direction, members of communities in Sierra Leone, as well as other communities in Liberia and Guinea, have created networks for the dissemination of knowledge about risk reduction response, by using their collective capabilities. Since all communities face similar crises such as irregular rainfall patterns and frequent drought, sharing information about when to plant seeds and how to procure drought resistant seeds has increased connectivity and interconnectedness among the communities (Mitleton - Kelly, 2011b). Knowledge sharing about risks across the community through informal channels has increased their ability to manage these risks. This self-organisation has been spontaneous and not initiated by government or any other external organisation.

It has been shown that spontaneous self-organisation occurs in conjunction with co-evolution and with positive and negative feedback loops among the agents (McKelvey, 1999). This is illustrated in Figure 1 by arrows connecting self-organisation with co-evolution and

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feedback loops. Co-evolution refers to the reciprocal effects of individual behaviours and choices (McKelvey, 1999). It occurs between connected and interdependent agents when influence and response are reciprocal (Mitleton-Kelly, 2004).

As agents co-evolve, positive and negative feedback loops also operate in tandem. Positive feedback refers to events that act to augment or reinforce the outcome of small actions (Sammut-bonnici & Wensley, 2002). Negative feedback loops, on the other hand, are stabilising forces and push the system towards equilibrium (Mitleton-Kelly, 2003). Positive feedback drives change, whereas negative (balancing, moderating, or dampening) feedback maintains stability in a system (Mitleton-Kelly, 2003).

The following example illustrates co-evolution and feedback loops within the venture capital community. Large information technology firms as well as small private firms adopt Venture capital (VC) practices by establishing VC programs to generate financial returns. There is a co-evolutionary relationship between the private and corporate venture investing activities, in that the investments made by one affect the other's investment and follow a cyclical pattern. There also exists a positive feedback relationship between private and corporate venturing and initial public offering (IPO) and stock markets driving the investments of private VC firms. Increases in stock prices and IPO markets lead to increases in investments in the private VC populations. Also, positive feedback loops between the private and corporate VC programs lead to an increase in venture capital investments (Gaba & Meyer, 2008; Gaba & Meyer, 2006).

As co-evolution develops, the co-existence of order and disorder can be observed. In the centre of Figure 1, this is labelled as 'edge of chaos'. This label describes a state in which multiple and diverse forms or dissipative structures (Prigogine & Nicolis, 1967; Prigogine &

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Stengers, 1985) are being created. At the micro-level within an organisation, these dissipative structures are sources of innovation and diversification and open up multiple opportunities for innovation and diversification of the organisation (e.g. multiple solutions to a problem) (Kuosa, 2007; Mitleton-Kelly, 2003, 2004, 2006; Mitleton-Kelly & Papaefthimiou, 2000). There is increased short term predictability, as patterns begin to emerge, however the long term emergent behaviours are still unpredictable (Kemp, 2009; Stacey, 1995). For example, during periods of organisational anxiety, while irregular patterns of behaviour (short term patterns) can be identified among organisational members, the specific manifestation of these patterns is unpredictable (Stacey, 1995).

The emergence of these patterns is also path-dependent, as shown in the centre of Figure 1. Initial steps in a particular direction induce further movement in the same direction (Arthur, 1999; Hong, 2013; Kuosa, 2007). A commonly cited example of path-dependence is the history of the Beta and VHS video recording formats (Koch, Eisend, & Petermann, 2009). As VHS video recorders become slightly more popular than Beta recorders, it led to the production of more films in VHS format. That in turn increased the incentive for others to buy VHS rather than Beta. In this way, an incremental difference in initial market shares was able to set off self-reinforcing cycles (Mitleton-Kelly, 2003).

Along with path-dependence, historicity also plays a role in the emergence of organisational behaviours. These behaviours are influenced by past organisational choices and decisions which become part of the organisational history (Mitleton-Kelly, 2003). The history of past decisions, actions, unintended routines and capabilities of the firm's operation, influences emergent organisational behaviours (Ioannides, 2003).

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Guided by organisation's deep structure, a pattern develops into the emergent organisational behaviour at the higher level. For example, at Intel Corporation, the decision to choose between a strategic focus on microprocessors and a focus on memory was guided by the organisation's internal selection environment (Burgelman & Grove, 1996). This is shown in the extreme right of Figure 1. Within the organisational context, emergence includes the development of new solutions, new super-agents, new rules and new cognitive patterns ('schema') among participants in the organisation (Rhodes, 2008). An example of emergent behaviour shown by teams is when they develop novel solutions to problems, which would not have been possible in isolation (Mitleton-Kelly & Ramalingam, 2011).

To summarise, in CESs connectivity and interdependence enable agents to spontaneously self-organise. Self-organisation occurs in conjunction with co-evolution and with positive and negative feedback loops. Multiple behavioural patterns emerge, in the form of dissipative structures. This emergence is guided by path dependence and historicity. Micro-level behaviour, at the level of individuals in the organisation, is characterised as situated at the 'edge of chaos', since it is a point where order and disorder co-exist. Organisational deep structure then facilitates the emergence of particular behaviours at the macro-level. This emergent behaviour leads to emergent organisational outcomes. This process enables CESs to respond to challenges of far-from equilibrium conditions.

Referring back to the Branson example, we can conceptualise the town as a CESs. When increased diversity in the community created far-from equilibrium conditions, Branson emerged from an obscure little town into a thriving tourist destination. Spontaneous self-organisation among members of the community, in conjunction with the transportation-tourism feedback loop

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and the organisational community–tourism feedback loop, helped drive the emergence of Branson’s theatres, restaurants, motels, shops, theme parks and amusements. The emergent outcome was the creation of the collective live musical theatres. Deep structure, in the form of community social norms, shaped the emergence of this behaviour (Chiles et al., 2004).

### **The Role of Management**

The integrative model presented above provides an account of the organisational processes and outcomes which enable CESs to respond to the challenges of far-from equilibrium conditions. By conceptualising organisations as CESs, we can apply these dynamics and facilitate effective responses to climate change. In the subsequent section we review the role of management in conceptualising organisations as CESs and facilitating organisational responses to far-from equilibrium conditions. This will allow us to identify and improve managerial practices and strategies for responding to climate change.

Unlike the top-down control approaches characteristic of equilibrium assumptions, in CESs, organisational processes are driven from the bottom levels of the organisation (Anderson, 1999; Mitleton-Kelly, 2003; Stacey, 1995), where the actions of self-organising agents operating at the micro -level aggregate into emergent behaviours at the level of the whole organisation. In CESs, emergent behaviour is facilitated by connectivity and interdependence that result from long term interactions between self-organising agents (Osborn & Hunt, 2007; Stacey, Shaw, & Griffin, 2000). Therefore, management’s role is to create and build capacities for those interactions (between diverse agents) which are likely to promote self-organisation (Mitleton-Kelly, 2006).



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For example, in the case of a European branch of an international bank, when far-from equilibrium conditions were exacerbated due to the adoption of the Euro, the Project Manager created conditions which allowed self-organisation and emergence for successful transition to the Euro currency system. Monthly meetings among technology, business, and operations departments were initiated. There was constant dialogue between organisation members and the newly recruited information technology team. This led to micro-agent interactions that were neither managed nor controlled from the top, and allowed for the emergence of new behaviours and new ways of working. The new information technology system that emerged led to the successful transition of the bank into the Euro economy. The Project Manager could not exactly predict if and how the process would work. Contextual conditions such as autonomy encouraged self-organisation, and the new information system emerged. These conditions occurred ‘spontaneously’, in the sense that they were enabled, not planned or enforced (Mitleton-Kelly, 2003).

Based on the above example, we can conclude that, in order to develop organisational responses in far-from equilibrium conditions, management should create ‘enabling environments’ in organisations, which facilitate self-organisation and emergence (Mitleton-Kelly & Ramalingam, 2011). The concept of enabling environments refers to socio-cultural and technical conditions that facilitate the emergence of organisational outcomes in a far-from equilibrium state (Mitleton-Kelly, 2003). Such enabling environments would promote and support the emergence of new ways of working, new relationships and new power structures, and would facilitate effective responses in far-from equilibrium conditions (Mitleton-Kelly, 2006).

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It has also been observed that complicated authoritarian procedures or inhibiting structures such as tight budget control and lack of local autonomy often block or restrict self-organisation and emergence (Mitleton-Kelly, 2003). For example, in the case of a London based NHS hospital (we will refer to it as Hospital B), when faced with far-from equilibrium conditions due to a financial deficit, the new CEO relied on top-down control measures to bring about cost cutting. Due to power centralisation and lack of transparent communication, connectivity and interdependence among members were inhibited. Instead of trust and reciprocity, the organisation's members espoused feelings of anxiety and fear. Participation and contribution were constrained. All ideas needed to be approved by the senior team and the local team did not have any autonomy. The organisation did not provide any opportunity or environment for self-organisation or for the emergence of organisational behaviours and outcomes (Mitleton - Kelly, 2011a).

The proposed integrative model explains the underlying processes in CESs which enable them to respond to challenges of far-from equilibrium state. Managers can facilitate these processes by creating enabling environments which promote self-organisation and emergence. This will enable organisations to effectively address far-from equilibrium conditions. In the next section we apply the model to develop hypotheses about how organisations can develop effective climate change responses.

### **Awareness of far-from equilibrium and organisational responses to climate change: research hypotheses**

In order to analyse and evaluate possible connections between awareness of underlying processes of CESs in far-from equilibrium conditions and organisational responses to climate

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change, we focus on two aspects: (1) drivers for climate change responses generation; and (2) increasing effectiveness of climate change responses. The first aspect investigates possible causal relationships and/or factors that would lead organisations to respond to the far-from equilibrium challenges of climate change. The second aspect emphasizes organisational interest in developing effective responses to climate change.

### 1. Drivers for response generation

Climate change has led to the appearance of persistent far-from equilibrium characteristics in the contemporary business environment (Winn et al., 2011). The physical impacts of climate change are highly disruptive for business organisations to variable and varying extents (Lisø, 2006).

As explained by the proposed model of organisational processes as CESs, in a far-from equilibrium state emergent organisational behaviours lead to unpredictable, emergent organisational outcomes. In the previous Hospital A for example, the CEO was aware of CESs perspective of organisations and was therefore able to facilitate emergent cross-departmental teams in response to the financial deficit (Mitleton - Kelly, 2011a). An organisation which is more aware of CESs properties is more likely to take actions to respond to far-from equilibrium conditions and respond to climate change. Therefore it is hypothesised that,

H1. At the organisational level, decision makers' awareness of organisations as CESs will act as a driver of organisational response to climate change.

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### 2. Effectiveness of climate change responses

The effectiveness of climate change responses is defined by two further factors: enabling environments and simple decision rules.

#### 2.1 The role of enabling environments

While awareness of CESs perspective is the starting point, it does not guarantee effective responses in far-from equilibrium conditions. For example, in the previous study of London hospitals, in the case of Hospital A, even though management was aware of far-from equilibrium characteristics and CES behaviours, desirable and effective outcomes were not sustained due to lack of knowledge transfer between the CEO and mid-level management (Mitleton - Kelly, 2011a). If the hospital management had created an enabling environment which facilitated knowledge sharing and learning, desirable organisational outcomes would have been sustained. A review of organisational climate change literature also reveals the desire for facilitating collaborations, networking, experimentation and organisational learning to develop effective responses to climate change (Okereke et al., 2012; Winn et al., 2011).

It is therefore hypothesised that,

H2a. The presence of an enabling environment will lead to more effective organisational climate change responses.

H2b. The presence of an inhibiting environment will not lead to more effective organisational climate change responses.

#### 2.2 The role of simple decision rules

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From our previous discussion we conclude that top down control mechanisms are not efficient in a far-from equilibrium state (Chiles et al., 2004). Rigid plans and procedures set by management may inhibit self-organisation and the spontaneous emergence of organisational behaviours and outcomes. Extensive planning and setting up of stringent work routines and procedures constrains emergence of organisational behaviours and outcomes as CESs.

For example, during a merger and acquisition of a service sector firm, a detailed plan of action for designing the restructured organisation was created. The plan was to be executed by Department heads, and it was assumed that the resultant new organisation would be successful. The integration plan listed detailed rules and procedures to be executed. This created high levels of formality and constrained communication. Two years after the merger, the two businesses were still not integrated in terms of organisational structure and culture, and existed as separate entities. Integration failed due to the presence of rigid and complex rules which inhibited the emergence of desirable organisational outcomes such as cultural integration (Mitleton-Kelly, 2004).

Therefore, instead of setting strict organisational rules and regulations, a set of simple decision rules such as rules about what types of opportunities should be pursued (boundary rules) and which opportunities are most valued (priority rules) should be set (Paarlberg & Bielefeld, 2009; Sull & Eisenhardt, 2012). For example the Alachua County Organisation for Rural Needs, Inc (ACORN) clinic is well known for providing quality health care through patient engagement. According to Lemak and Goodrick (2003), this has been achieved by using very simple rules for designing organisational functions. For instance, there are rules that assign a patient to a specific practitioner, but there are no specific guidelines about how those practitioners further coordinate

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with other specialist consultants, burden of paperwork on the patients (Lemak & Goodrick, 2003). It has been observed that generic and less prescriptive rules enable desirable organisational outcomes.

It is therefore hypothesised that,

H4. Simple decision rules are likely to enable the emergence of effective organisational climate change responses.

### **Discussion, implications and future research**

In this paper we have developed an explanatory model of organisational processes in far-from equilibrium conditions by adopting a CESs perspective of organisations. We have also proposed review based hypotheses for improving organisational responses to climate change. These can generate recommendations for designing organisational structures and managerial practices for effective climate change responses.

The integrative model presented is based on a review of literature. By testing the proposed hypotheses, one can assess to what extent managerial actions based on CESs behaviours and far-from equilibrium awareness (e.g. the creation of enabling environments and the application of simple decision rules) may improve the generation of ecologically, globally desirable organisational outcomes through organisational climate policies. If these hypotheses are validated, then more specific recommendations could be formulated to facilitate enabling environments and simple decision rules which will increase organisational effectiveness in responding to climate change.

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This paper has presented an explanatory model and generated hypotheses about how organisations may use their awareness of far-from equilibrium characteristics and CESs behaviours to effectively respond to climate change. Results from further empirical validation of the above hypotheses can help to identify specific features of globally desirable enabling environments and simple decision rules.

### **Conclusion**

The purpose of the paper was to present a model of organisations as CESs for understanding organisational behaviours and outcomes when organisations are in a far-from equilibrium state. The current models employed to explain organisational outcomes were critically reviewed. Organisational behaviours and outcomes at far-from equilibrium are a result of the self-organisation of interdependent agents via enabling environments and simple decision rules.

Complex climate change has made more explicit the current reality of business environments at far-from equilibrium. The application of our proposed model of organisations as CESs to this issue increases organisational effectiveness in meeting the challenges of climate change. Since organisations can be conceptualised as CESs, they could develop enabling environments and simple decision rules that lead to effective climate change responses.

### References

- Abbott, A. (1988). Transcending General Linear Reality. *Sociological Theory*, 6(2), 169-186.
- Alvesson, M., & Sandberg, J. (2011). Generating research questions through problematization. *Academy of Management Review*, 36(2), 247-271.
- Andersen, P. (1999). Complexity Theory and Organization Science. *Organization Science*, 10(3), 216-232.
- Arthur, W. B. (1999). Complexity and the Economy. *Science*, 284(5411), 107-109.
- Boulton, J., & Mitleton-Kelly, E. (2010). Editorial--policy and climate change. *Emergence: Complexity and Organization*, 12(2), 1-6.
- Burgelman, R. A., & Grove, A. S. (1996). Strategic Dissonance. *California Management Review*, 38(2), 8-28.
- Chiles, T. H., Meyer, A. D., & Hench, T. J. (2004). Organizational Emergence: The Origin and Transformation of Branson, Missouri's Musical Theaters. *Organization Science*, 15(5), 499-519.
- Chiles, T. H., Vultee, D. M., Gupta, V. K., Greening, D. W., & Tuggle, C. S. (2010). The Philosophical Foundations of a Radical Austrian Approach to Entrepreneurship. *Journal of Management Inquiry*, 19(2), 138-164.
- Choi, T. Y., Dooley, K. J., & Rungtusanatham, M. (2001). Supply networks and complex adaptive systems: control versus emergence. *Journal of Operations Management*, 19(3), 351-366.
- Enkvist, P.-A., Naucler, T., & Oppenheim, J. M. (2008). Business Strategies for Climate Change. *The McKinsey Quarterly*(2), 24-33.



## ORGANISATIONAL PROCESSES AS COMPLEX EVOLVING SYSTEMS

- Furrer, B., Hamprecht, J., & Hoffmann, V. H. (2012). Much Ado About Nothing? How Banks Respond to Climate Change. *Business & Society, 51*(1), 62-88.
- Gaba, V., & Meyer, A. D. (2008). Crossing the organizational species barrier: how venture capital practices infiltrated the information technology. *Academy of Management Journal, 51*(5), 976-998.
- Gaba, V., & Meyer, D. A. (2006). *Structural forms of corporate venturing*. Working Paper. University of Oregon, Eugene, and INSEAD, Singapore.
- Haigh, N., & Griffiths, A. (2012). Surprise as a Catalyst for Including Climatic Change in the Strategic Environment. *Business & Society, 51*(1), 89-120.
- Haveman, H. A., Russo, M. V., & Meyer, A. D. (2001). Organizational Environments in Flux: The Impact of Regulatory Punctuations on Organizational Domains, CEO Succession, and Performance. *Organization Science, 12*(3), 253-273.
- Holland, O., & Melhuish, C. (1999). Stigmergy, Self-Organization, and Sorting in Collective Robotics. *Artificial Life, 5*(2), 173-202.
- Hong, K.-j. (2013). The unintended consequences of the Helsinki Final Act: A path emergence theory perspective. *International Political Science Review, 34*(3), 310-325.
- Ioannides, S. (2003). Orders and Organizations. *American Journal of Economics and Sociology, 62*(3), 533-566.
- Kauffman, S. A. (1990). The Sciences of Complexity and "Origins of Order". *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association, 1990*, 299-322.
- Kemp, S. (2009). Unpredictability and Nonlinearity in Complexity Theory: A Critical Appraisal. *Emergence: Complexity & Organization, 11*(1), 84-93.

## ORGANISATIONAL PROCESSES AS COMPLEX EVOLVING SYSTEMS

- Koch, J., Eisend, M., & Petermann, A. (2009). Path Dependence in Decision-Making Processes: Exploring the Impact of Complexity under Increasing Returns. *Business Research*, 2(1), 67-84.
- Kuosa, T. (2007). A few extensions to path-dependence and emergence in complex social systems. *Emergence : Complexity and Organization*, 9(4), 3-16.
- Lemak, C. H., & Goodrick, E. (2003). Strategy as simple rules: understanding success in a rural clinic. *Health Care Management Review*, 28(2), 179-189.
- Lichtenstein, B. B. (2000). Emergence as a process of self-organizing: New assumptions and insights from the study of non-linear dynamic systems. *Journal of Organizational Change Management*, 13(6), 526-544.
- Lichtenstein, B. B. (2009). *Moving Far From Far-From-Equilibrium: Opportunity Tension as the Driver of Emergence*. College of Management Working Papers and Reports.
- Linnenluecke, M., & Griffiths, A. (2012). Assessing organizational resilience to climate and weather extremes: complexities and methodological pathways. *Climatic Change*, 113(3-4), 933-947.
- Linnenluecke, M., Stathakis, A., & Griffiths, A. (2011). Firm relocation as adaptive response to climate change and weather extremes. *Global Environmental Change*, 21(1), 123-133.
- Lisø, K. R. (2006). Integrated approach to risk management of future climate change impacts. *Building Research & Information*, 34(1), 1-10.
- Macintosh, R., & Maclean, D. (1999). Conditioned emergence: a dissipative structures approach to transformation. *Strategic Management Journal*, 20, 297-316.
- McKelvey, B. (1999). Avoiding Complexity Catastrophe in Coevolutionary Pockets: Strategies for Rugged Landscapes. *Organization Science*, 10(3), 294-321.

## ORGANISATIONAL PROCESSES AS COMPLEX EVOLVING SYSTEMS

- McKelvey, B. (2001). What Is Complexity Science? It Is Really Order-Creation Science. *Emergence*, 3(1), 137-157.
- McKelvey, B. (2004). Toward a complexity science of entrepreneurship. *Journal of Business Venturing*, 19(3), 313-341.
- McMullen, J. S., & Shepherd, D. A. (2006). Entrepreneurial Action and the Role of Uncertainty in the Theory of the Entrepreneur. *The Academy of Management Review*, 31(1), 132-152.
- Meyer, A. D., Gaba, V., & Colwell, K. A. (2005). Organizing Far from Equilibrium: Nonlinear Change in Organizational Fields. *Organization Science*, 16(5), 456-473.
- Mitleton-Kelly, E. (2000). Complexity: Partial Support for BPR? In P. Henderson (Ed.), *Systems Engineering for Business Process Change* (pp. 24-37): Springer London.
- Mitleton-Kelly, E. (2003). Ten Principles of Complexity and Enabling Infrastructures. In E. Mitleton-Kelly (Ed.), *Complex systems and evolutionary perspectives on organisations : the application of complexity theory to organisations* (pp. 23-50). Oxford: Pergamon.
- Mitleton-Kelly, E. (2004). *Co-Evolutionary Integration: A Complexity Perspective on Mergers & Acquisitions*. Paper presented at the 20th EGOS Colloquium, Slovenia.
- Mitleton-Kelly, E. (2006). A Complexity Approach To Co-Creating An Innovative Environment. *World Futures*, 62(3), 223-239.
- Mitleton-Kelly, E., & Papaefthimiou, M. C. (2000). Co-Evolution and an Enabling Infrastructure: A Solution to Legacy? In P. Henderson (Ed.), *Systems Engineering for Business Process Change* (pp. 164-181): Springer London.
- Mitleton-Kelly, E., & Puszczynski, R. L. (2004). *An integrated methodology to facilitate the emergence of new ways of organising*. Paper presented at the Proceedings of the 3rd European Conference on Research Methods: In Business and Management Studies.

## ORGANISATIONAL PROCESSES AS COMPLEX EVOLVING SYSTEMS

- Mitleton-Kelly, E., & Ramalingam, B. (2011). Organisational Learning and Complexity Science: Exploring the Joint Potential. The Sage Handbook of Complexity and Management. SAGE Publications Ltd. In P. Allen, S. Maguire & B. McKelvey (Eds.), *The Sage Handbook of Complexity and Management* London: SAGE Publications Ltd.
- Mitleton - Kelly, E. (2011a). A Complexity Theory Approach to Sustainability: A Longitudinal Study in Two London NHS Hospitals. *Learning Organization*, 18(1), 45-53.
- Mitleton - Kelly, E. (2011b). Identifying the Multi-Dimensional Problem-space & Co-creating an Enabling Environment. In A. Tait & A. R. Kurt (Eds.), *Moving forward with Complexity* (pp. 21-44): Emergent Publications.
- Morgan, G. (2006). *Images of organization*: Sage Publications
- Nancy, J.-L. (1990). *The inoperative community*. Minneapolis, MN: Minneapolis, MN : University of Minnesota Press.
- Okereke, C., Wittneben, B., & Bowen, F. (2012). Climate Change: Challenging Business, Transforming Politics. *Business & Society*, 51(1), 7-30.
- Ormerod, P. (1998). *Butterfly economics : a new general theory of social and economic behaviour*: London : Faber and Faber.
- Osborn, R. N., & Hunt, J. G. J. (2007). Leadership and the choice of order: Complexity and hierarchical perspectives near the edge of chaos. *The Leadership Quarterly*, 18(4), 319-340.
- Paarlberg, L. E., & Bielefeld, W. (2009). Complexity Science—An Alternative Framework for Understanding Strategic Management in Public Serving Organizations. *International Public Management Journal*, 12(2), 236-260.

## ORGANISATIONAL PROCESSES AS COMPLEX EVOLVING SYSTEMS

Prigogine , I., & Nicolis, G. (1967). On Symmetry-Breaking Instabilities in Dissipative Systems.

*The Journal of Chemical Physics*, 46, 3542.

Prigogine , I., & Stengers, I. (1985). *Order out of chaos : man's new dialogue with nature*.

London: London : Fontana Paperbacks.

Rhodes, M. L. (2008). Complexity and Emergence in Public Management. *Public Management*

*Review*, 10(3), 361-379.

Richardson, A. K. (2008). Managing complex organizations: complexity thinking and the

science and art of management.(Practitioner)(Report). *Emergence: Complexity and*

*Organization*, 10(2), 13.

Rothenberg, S., & Levy, D. L. (2012). Corporate Perceptions of Climate Science: The Role of

Corporate Environmental Scientists. *Business & Society*, 51(1), 31-61.

Sammut-bonnici, T., & Wensley, R. (2002). Darwinism, probability and complexity:

market-based organizational transformation and change explained through the theories of

evolution. *International Journal of Management Reviews*, 4(3), 291-315.

Senge, P. M., Carstedt, G., & Porter, P. L. (2001). Innovating Our Way to the Next Industrial

Revolution. *MIT Sloan Management Review*, 42(2), 24-38.

Shane, S., & Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research.

*The Academy of Management Review*, 25(1), 217-226.

Stacey, R. (1995). The science of complexity: An alternative perspective for strategic change

processes. *Strategic Management Journal*, 16(6), 477-495.

Stacey, R. (2007). The challenge of human interdependence Consequences for thinking about the

day to day practice of management in organizations. *European Business Review*, 19(4),

292-302.

## ORGANISATIONAL PROCESSES AS COMPLEX EVOLVING SYSTEMS

- Stacey, R., Shaw, P., & Griffin, D. (2000). *Complexity and management : fad or radical challenge to systems thinking?* London: London : Routledge.
- Sull, D., & Eisenhardt, K. M. (2012). Simple rules for a complex world: any strategy is more effective if employees have straightforward guidelines for making critical decisions.(The (Surprisingly) Simple Rules of Strategy)(Cover story). *Harvard Business Review*, 90(9), 68.
- Thistlethwaite, J. (2012). The ClimateWise Principles: Self-Regulating Climate Change Risks in the Insurance Sector. *Business & Society*, 51(1), 121-147.
- Varga, L., Allen, M. P., Strathern, M., Rose-Anderssen, C., Baldwin, J. S., & Ridgway, K. (2009). Sustainable Supply Networks: A Complex Systems Perspective. *Emergence: Complexity & Organization*, 11(3), 16-36.
- Winn, M., Kirchgeorg, M., Griffiths, A., Linnenluecke, M. K., & Günther, E. (2011). Impacts from climate change on organisations: a conceptual foundation. *Business Strategy & the Environment (John Wiley & Sons, Inc)*, 20(3), 157-173.
- Zammuto, F. R., & Cameron, S. K. (1985). Environmental Decline and Organisational Response. *Academy of Management Proceedings*, 8(1), 250-254.