# A COMPLEXITY SCIENCE-BASED MANAGEMENT FRAMEWORK FOR VIRTUAL ORGANISATIONS

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## Abstract

The virtual organisation challenges traditional management assumptions because a new means of coordinating globally dispersed employees is needed. To understand the collective activities of a workforce separated by space and time, this paper describes a complexity science-based management framework for virtual organisations. Specific focus is on a South African virtual organisation as a complex adaptive system. A single, embedded case study strategy was followed, and multiple data sources used to generate theory. In this paper, results are reported that clarify the management of an organisation where technology replaces conventional face-to-face contexts for socialisation and assimilation. The paper shows how managers create a virtual context for sharing meaning and interaction through synergy, empowerment, participation and an accountable, committed workforce.

JEL classification: D21, J24, J53

**Keywords:** virtual organisation, management, complexity science

## 1. INTRODUCTION

Technological breakthroughs in connectivity have extended the reach of organisations and individuals. This paper focuses on the virtual organisation, which exists as a network of dispersed individuals and organisations linked by technology to rapidly respond to turbulent environments and exploit market opportunities. The nature of the virtual organisation exacerbates the need for revised management practices, because managers must coordinate multiple transactions and tasks, and a geographic and temporally dispersed workforce connected by virtual networks. However, the outcomes of environmental influences, interactions within and between organisations, and constant technological innovation are unpredictable.

To make sense of unpredictability and instability, this study adopted complexity science as meta-theory to understand the virtual organisation, and management thereof, as a dynamic, non-linear, complex adaptive system. While the literature is clear on the implications and challenges for management, research on how these are addressed in practice is limited. Additionally, research focusing on the management of South African virtual organisations is absent.

This paper provides a conceptual, complexity science-based management framework for virtual organisations. Results describing the management of a South African virtual organisation, namely SchoolNet South Africa (SNSA), as a complex adaptive system are reported. A brief background to the study is provided, followed by a discussion of the research design, a summary of key results, and conclusions of the study.

## 2. COMPLEXITY SCIENCE AS META-THEORY

### *2.1 COMPLEXITY SCIENCE AND CONCEPTUALISATION*

We followed a complexity science meta-theoretical framework. Complexity science "embodies a non-linear systems-oriented perspective that attempts to conceptualise and understand organisation systems at multiple levels in full recognition of the dynamic linkages and influences that operate within and between aspects of those systems levels through time and space" (Cooksey; 2001, 78).

The relevant aspect of complexity science for this study is the complex adaptive system. Viewing an organisation as a complex adaptive system has many implications. The non-linearity of interdependent components means that the organisation cannot be studied in terms of its constituent parts alone, or of what each unit does in isolation (Anderson; 1999, 217). Complex adaptive system behaviour is induced not by a single entity but rather by the simultaneous and parallel actions of agents by the system itself (Dooley; 2002, 220). Behaviour of the system is therefore emergent, where emergence refers to the arising of new, unexpected structures, patterns, properties, or processes in a self-organising system.

The principles of self-organisation generate a new approach to management because it emphasises adapting to rapid and constant change (Lichtenstein; 2000, 527). Key managerial issues therefore shift from maintaining control to supporting the emergence of new order. This is because in complex adaptive systems organising is a mutually interdependent process between agents (actors).

For this reason we incorporated the postmodern research approach, and structural and functional perspectives into the study. The postmodern process approach emphasises "intricate patternings of relationships" (Chia; 1995, 587), which are micro-organising processes, or micro-logics, that enact organisations. Furthermore, they are "discrete behavioural process events" that bring about self-organisation and manifest an emergent reality, which can culminate in adaptations to organisation structure, culture and strategy (McKelvey; 1999:7).

Based on the above, the first stage in conceptual development involved the identification of organisation concepts or dimensions. In the second stage, we "unbundled" these concepts into sub-concepts (indicators). The conceptual

framework comprised the dimensions of organisation design, namely technology, structure, culture and strategy, each of which is mutually dependent. These concepts are "sets of forces in dynamic equilibrium among themselves" (Introna; 2001:146), which determine the forming of structure (Afuah & Tucci; 2003, 66; Rybakov; 2001, 89) and provide options for strategic and organisation adaptation (Lewin et al.; 1999, 541). This framework guided the re-conceptualisation and empirical exploration of the virtual organisation as a complex adaptive system.

### *2.2 THE VIRTUAL ORGANISATION*

Virtual organisations represent new organisation forms that facilitate technological demands (Black & Edwards; 2000, 567). The virtual organisation is an information-intensive organisation form (Child & McGrath; 2001, 1135) that centres round the knowledge of workers linked by technology across space and time. While a clear definition of the virtual organisation is forthcoming (Kasper-Fuehrer & Ashkanasy; 2003-4, 35), there is general consensus that it is not a hierarchical structure but rather a type of network organisation. As such, it facilitates open access to and exchange of information throughout the network and across organisation boundaries.

In virtual organisations, the collapse of space and time highlights the need for a management approach that enables flexibility, coordinated communication and adaptability to address emerging issues regarding a dispersed workforce. Therefore, virtual operations require organising efforts that move beyond efficiency and control to ones that emphasise the ability to identify or create opportunities and gather the needed players to exploit them. The virtual organisation is described as a complex adaptive system in section 4.1.

## 3. RESEARCH DESIGN AND METHODOLOGY

We followed an ideographic, exploratory and cross-sectional case study strategy to generate theory. We first derived *a priori* concepts from an extensive systematic review of the literature to formulate stringent selection criteria for the identification of the case for analysis. From this the virtual organisation was re-conceptualised (as a structure, a process and a complex adaptive system) to formulate working definitions for the study. We then classified types of virtual organisations on a traditional/real-virtual continuum to select a case as close as possible to the "ideal" virtual type, or online virtual organisation. Based on this, SchoolNet South Africa (SNSA) was selected as the case for analysis, positioned at the virtual end of the traditional/real-virtual continuum. We used multiple sources of qualitative data, namely documents, e-mail interviews, self-type paragraphs and the Delphi method.

## 4. KEY RESULTS AND DISCUSSION

Results were reported as a descriptive case study. Only those results relevant to managing the virtual organisation as a complex adaptive system are provided in this paper.

### *4.1 THE VIRTUAL ORGANISATION AS COMPLEX ADAPTIVE SYSTEM*

Management implications are highlighted by first describing the virtual organisation as a complex adaptive system.
Empirical results of the study show that the virtual organisation is comprised of a large number of entities that display a high level of interactivity. It consists of a core organisation which coordinates and integrates core competencies and the resources of partners. Components of the system, namely the core and extended organisation (partners), comprise a **loosely coupled network** based on structural and cultural relationships. During configuration partners are identified and selected based on extant values and purposes that can be co-aligned. The selection process reduces the types of individuals (actors) or agents that can inhabit the system (the virtual organisation) to those that can co-exist or have synergy with the other types present (Allen; 2001, 13). Therefore, the co-alignment of goals and purposes is important.
Regular interaction and communication facilitate **co-existence** and **synergy**. All complex adaptive systems are composed of and maintained by a flow of energy/resources from the environment. Emergent structural configurations or patterns of relationships enable goal attainment, while simultaneously the achievement of goals reproduces the configuration. Therefore, a high level of **interactivity** is vital for coordination, which takes place in extensive communication networks. Through interaction **knowledge** is acquired, created or shared and information disseminated to ensure productivity and efficiency. Technology provides the context for interaction and relationship building, and amplifies interactions and influences across the traditional boundaries of time and space. The nature of interaction is **non-linear**, meaning that the virtual organisation cannot be reduced to its individual components.

This means that **environmental influences** impact the functioning of the virtual organisation. For example, an environmental event (such as the entry of a new competitor) can propel the organisation beyond the limits of its capacity. When limits are reached, tension and threshold threaten to throw the organisation out of equilibrium. A **beyond equilibrium** state arises when influences, either through threat or opportunity, force the organisation to adapt and re-align resources. The re-alignment of resources could mean re-configuration and re-integration because the organisation is able to exhibit dynamic behaviour in this state.

The **uncertainty** created by the non-linearity of interactions is **amplified** due to the technological nature of the system. Technology amplifies feedback events because it increases the range of influence by providing a context connecting every aspect of the virtual organisation. Therefore, the virtual organisation is constantly subject to **input** from the environment. To avoid being catapulted into a chaotic state the **culture** of the organisation (or dominant logic according to Lichtenstein, 2000), co-destiny, a common purpose, and shared commitment to common goals serve as the strange attractor around which the organisation revolves.
A dominant logic is reproduced (**organisation culture**) from the interactions of values, beliefs, structures and strategies, while at the same time that logic determines the configuration of values, structures and strategies. This dynamic process can be described in terms of organisational learning because the system self-generates meaning and knowledge to maintain itself and develop over time. This is influenced by **structure**, which determines the capacity for learning and accomplishing goals through the mobilisation of resources. When the level of resources needed to self-generate the organising configuration or dominant logic are exceeded, the system begins a process of transformation. **Transformation** occurs through synergy and organising processes to reduce equivocality (uncertainty) while the organisation attempts to find a better way to organise, either through strategic re-direction or purposive organisation building processes. This leads to the **emergence** of a new dynamic order underscored by information and communication.

However, evidence in this study indicated that a beyond equilibrium state is not a necessity for complex adaptive system behaviour. Rather, **adaptive capability** is increased by the non-enforcement of structures and hierarchies, free-flowing information, continuous communication, and the micro-logics of the organisation. Furthermore, the organisation can **purposefully respond** to environmental influences without the occurrence of major change. Here, flexible, permeable, dynamic "non-structures" are emphasised. This creates the conditions for **self-organisation** due to the freedom from constraints offered by decreased structural control, less reliance on traditional hierarchies (hierarchies exist in communication structures), empowerment, trust and an all-embracing cultural core that extends to all actors/agents.

Additionally, empirical evidence shows that **self-organisation** does not create structures in the traditional sense (vertical or horizontal). Rather, it leads to the **emergence of communication networks** that increase interactions and may or may not be hierarchical. Furthermore, the micro-logics of organising mean that the virtual organisation is in a constant state of flux, this evident in organisation behaviour. **Emergence** is evident in the structures that form as a result of partnerships during configuration and integration. However, these structures revolve around the microscopic behaviours of the organisation, therefore

emergence is evident in the patterns of relationships that are formed. This is due to the self-organisation of actors as they arrange themselves to best achieve organisational goals. **The virtual organisation therefore structures itself around the patterns of actor' relationships and not the other way round**. These patterns are not predictable, show coherence (lower-level components, namely the micro-logics of organising, are united on a higher-level in communication structures), and are dynamic.

**Patterns of relationships** form as a result of **synergy** created between components (actors/agents) of the system. Synergy improves the flow of **tacit** knowledge, which culminates in an outcome that is greater than the sum of its parts. Synergy therefore drives the virtual organisation through the creation of knowledge and the formulation of strategies based on the context for improvisation it provides. Therefore, strategy is formulated around culture, synergy, relationships and interactions.

In addition, the behaviour of complex adaptive systems is determined by the nature of interactions and not by what comprises components. Each element in a dynamic system is interdependent and depends on other elements for its identity and function (Lichtenstein; 2000). Mutual dependence implies that actions and structures are mutually constituting and arise simultaneously over time. During organising action, reaction and learning arise mutually to create a **collective** mind (community nature of virtual organisations). Knowledge flows are also mutually constituting and mutually dependent. Therefore, structures have limited influence on resultant behaviours.

Interactions are rich, dynamic and underscored by **feedback** (communication). This highlights the importance of **relationships** in virtual organisations. Relationships are fundamental to all agents in the complex adaptive system. In the virtual organisation these relationships are the cornerstone of culture and dependent on building and sustaining trust. **Trust** serves as the coordination mechanism in virtual organisations.

In summary, and of importance to managers, the structures of the virtual organisation are fluid and form around relationships which self-organise in the flexible technological context of the virtual organisation. This leads to the emergence of communication structures, rather than traditional hierarchical structures.

### *4.2 MANAGING THE VIRTUAL ORGANISATION*

Results of the study indicate that managers in virtual organisations follow a servant-leadership approach. Servant leadership is based on the assumption that work exists for the development of the worker as much as the worker exists

to do the work (Daft & Marcic; 2004, 435). Virtual organisation managers strive to fulfil workers' goals and needs and realise the larger purpose or mission of the organisation. They are people- and results-oriented, focusing on people to achieve results.
Results further indicate that managers in virtual organisations share power, ideas and information, and acknowledge the achievements of others. They value people, encourage and create opportunities for participation, share power, create the context for synergy and improvisation, and build and sustain trust through regular communication. Organisation building and behavioural processes are emphasised. To summarise, managers in virtual organisations:

- **Empower** employees to make decisions by focusing on developing skills and abilities, and regular communication and feedback (bottom-up and top-down empowerment).
- **Delegate** to develop skills and focus on the "bigger picture" of virtual organisation through clearly articulated goals, participative decision-making and feedback.
- **Recruit wisely**: This often relies on intuition. The new recruit "fits" with the existent organisation culture and value system.
- **Communicate** for effective coordination, information sharing and knowledge sharing. The main purpose of communication is to reduce equivocality. Communication is transparent, and frequent and consistent for both task and relational purposes.
- **Build culture** by establishing trust, instilling organisation values, and by aligning personal goals with the organisation's mission. Culture building results in empowered employees. Managers must establish a culture of virtuality to build and sustain a strong, innovative organisation culture. This occurs in a context with very limited face-to-face interaction.
- **Focus on knowledge**, emphasising the sharing of tacit knowledge. Knowledge is created by providing the context for synergy and the sharing of tacit knowledge such as in brainstorming sessions or think tanks.
- **Establish trust**: Trust is based on the credibility of the manager, where credibility refers to the ability to engender trust in others and is based on the expertise of the manager.

For the interactions and continuous information exchange needed for complex adaptive systems behaviour, virtual organisation management:

- Is participative and democratic to enable collective learning across flatter hierarchies.
- Is adaptable and flexible to accommodate deviations from standard practices so as to respond to change. Strategic flexibility enables emergent strategy design.

- Builds a culture based on trust and a strong value system to empower employees. This creates a secure context that ensures that actors are more amenable to change.
- Decentralises decision-making to create a flexible structure for the emergence of autonomous informal groups. In addition, decentralised authority increases the adaptive capability of the organisation and its actors.
- Creates the context for synergy and improvisation by disseminating and sharing knowledge. Establishes open systems of communication for the regular sharing of information.
- Continuously engages in environmental scanning to: keep abreast of industry trends, developments and opportunities; build networks of beneficial contacts; acquire knowledge; and build credibility through expertise.

## 5. CONCLUSION

Fuelled by technology, information and communication, the virtual organisation exists in cyberspace, and is built on participation, synergy and improvisation. Virtual organisations will radically change the way we work and the way communication and interaction are viewed, practiced and studied. Likewise, management practices will adapt and evolve to accommodate these changes.

The virtual organisation provides a new context for organising and presents numerous challenges to managers because it is unrestricted by the traditional boundaries of space and time. Bringing the boundaryless opportunities of virtual organisation to full fruition is the role of a new breed of managers in a relatively young information era.

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