Organisation, Innovation and Emergence

By

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Summary

Theories of organisational innovation incorporate many ideas derived from, or related to, complexity theory. This is what sets organisational theories focused on innovation apart from mainstream management theories focused on control and coordination. However, complexity theory is treated as an inspiration, rather than a significant consideration in these theories.

The thesis is an inquiry into the relevance of one of the concepts from complexity theory, namely emergence, to our understanding of innovation in an organisational context. The question explored is how the notion of emergence explain aspects of innovation. Unfortunately, even in complexity theories relying on it, the concept of emergence is often not properly explained beyond a simple definition that the emergent[1] "whole is more than the sum of its parts" and can therefore not be explained by reductionist means that only focus on the constituent parts.

The introduction develops the problem by relating themes common to the phenomena of management, innovation, and organised complexity. Using selected theories, the chapter shows how ideas from complexity theory became adopted by organisation and management thinkers.

Chapter 2 offers an overview of extant theories of innovation and distinguishes diverse types of innovation found in the organisational context. The following theories are reviewed: Dey's enablers of innovation, Holland's complex innovation process, Chesborough's open innovation concept, Weick's social creation, and a model of diffusion of innovation. It is demonstrated how these theories were inspired by and rely on ideas from complexity science.

Chapter 3 turns to emergence, the concept at the heart of complexity theory. The chapter offers an overview of Emmeche, Køppe, and Stjernfelt's ontology of levels and their attempt to give substance to the concept of emergence. To relate these ideas to organisations, it is shown how emergence operates in Polanyi's Gestalt inspired theory of knowledge.

[1] Phenomena that exhibits the evidence of the process of emergence.

Chapter 4 considers how selected themes from emergence relate to the innovation theories described in the thesis.

Finally, in Chapter 5 three possible answers are offered about how emergence can help to understand organisational innovation. Emergence is a viewpoint of the full innovation process or it can indeed be a useful prescription for how to organise in order to innovate. It may offer a metaphor or analogy for part of the innovation process. It is concluded that emergence is a useful metaphor for the creative phase of the innovative process.

Opsomming

Teorieë van organisatoriese innovasie bevat baie idees afkomstig van, of verwant aan, kompleksiteitsteorie. Dit is wat organisasie teorieë fokus op innovasie anders maak as die hoofstroombestuursteorieë wat op beheer en koördinasie fokus. Die kompleksiteitsteorie word egter as 'n inspirasie, eerder as 'n sentrale oorweging, in hierdie teorieë beskou.

Die tesis is 'n ondersoek na die relevansie van een van die konsepte van kompleksiteitsteorie, naamlik ontvouing ("emergence"), tot ons begrip van innovasie in 'n organisatoriese konteks. Die vraag wat ondersoek word, is die mate waarin ontvouing kan help om aspekte van innovasie te verduidelik. Ongelukkig, selfs in kompleksiteitsteorieë wat daarop staatmaak, word die konsep van ontvouing dikwels nie behoorlik verduidelik nie, behalwe vir 'n eenvoudige definisie dat die ontvouende "geheel meer as die som van sy dele is" en dus nie verklaar kan word deur reduksionistiese metodes wat slegs op die samestellende dele fokus nie.

Die inleiding ontwikkel die probleem deur die temas wat algemeen verband hou met die verskynsels van bestuur, innovasie en georganiseerde kompleksiteit met mekaar in verband te bring. Die hoofstuk toon die mate waartoe idees van kompleksiteitsteorie deur organisasie– en bestuursdenke oorgeneem is.

Hoofstuk 2 bied 'n oorsig van bestaande teorieë van innovasie en onderskei verskillende soorte innovasie wat in die organisatoriese konteks voorkom. Die volgende teorieë word beskryf: Dey se instaatstellers van innovasie, Holland se komplekse innovasieproses, Chesborough se oop-innovasiekonsep, Weick se sosiale skepping, en 'n model van die verspreiding van innovasie. Daar word getoon hoe hierdie teorieë geïnspireer is deur en vertrou op idees uit kompleksiteitswetenskap.

Hoofstuk 3 draai na ontvouing, die kernkonsep van kompleksiteitsteorie. Die hoofstuk bied 'n oorsig van Emmeche, Køppe, en Stjernfelt se ontologie van vlakke en hul poging om die konsep van ontvouing uit te bou. Om hierdie idees aan organisasies te koppel, word aangetoon hoe ontvouing in Polanyi se Gestalt-geïnspireerde kennisteorie funksioneer.

Hoofstuk 4 oorweeg hoe geselekteerde temas uit ontvouing betrekking het op die innovasieteorieë wat in die tesis beskryf word.

Ten slotte word in Hoofstuk 5 drie moontlike antwoorde aangevoer oor die mate waarin ontvouing kan help om innovasie in organisasies te verstaan. Ontvouing is 'n siening van die volle innoveringsproses, of dit kan inderdaad 'n nuttige voorskrif wees vir hoe om te organiseer ten einde te innoveer. Alternatiewelik kan dit 'n metafoor of analogie bied vir 'n deel van die innovasieproses. Daar word tot die gevolgtrekking gekom dat ontvouing 'n nuttige metafoor is vir die kreatiewe fase van die innoverende proses.

Acknowledgements

My concept of patience has changed.

Thank you to:

Mr. Christiaan Maasdorp who let me focus. He questioned and persisted better than I did.

To a mentor, Richard Maasdorp, who congratulated me for challenging myself when I started this journey. So, he was with me at the departure terminal and sent me off.

I marvel at the fact that two individuals separated by space and disciplines but with similar names were very inspirational in this work.

My mother wanted to understand my pursuits and passed on in January 2016 still trying, I think. My father had also left us earlier after he, with her, laid the foundation. The deeper story of their contribution cannot be explained in a few words. But there must be meaning.

My brother and I debate ideas. Long ago, we realised we had followed different paths disposed to variant terminology addressing not so dissimilar concepts. We still must discover my twin brother's part in all this.

With Nelson, a workmate, we discuss and explore. With him I secretly test hypotheses. He welcomes momentary diversions from his tasks to sharpen his intellectual tools!

Finally, to my wife, daughter and son who endured and kindly supported me through their endurance of my withdrawal and wander in thought. They persevered, and I bear witness that it was not easy for them. There is their heavy hand bearing on the forthcoming pages. My wife reminded me to finish what I started. passion has victims. Passion must, in turn, in equal measure too, reward. There is no point for a burning passion other than that fact.

> *And the LORD God formed man of the dust of the ground and breathed into his nostrils the breath of life; and man became a living soul.*[2]

Created, scaled and emerged.

[2] Genesis 2 verse 7, King James Version

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Chapter 1
Complexity, Emergence and Innovation

1.1 Introduction

The sustainability of organisations, amongst other aspects, depends on how well they innovate. That need to innovate exists in a complex environment. That complexity has been the subject of many studies within this century and the previous one.

Complexity has been used in the explanation of networks, both animate and inanimate. It is one of the most satisfying theories in the analysis of organisation and organisations. Numerous studies under its theme, adding new and valuable knowledge that is quite significant to modern civilisation.

Within complexity, a key notion, emergence, is one of its markers.

This study explores the implications of the knowledge of complexity, and especially emergence, in selected theories, on the processes innovation.

There is a need to investigate the relationship between complexity, emergence and innovation to open new areas of focus for organisations and individuals involved in innovation. This is because most of the attention, with respect to innovation, has been on its "mechanical" dimension. A significant amount of information and knowledge has been created on its linear and mechanical aspects as opposed to its non-linear dimension.

Some authors have written on the special relationship between emergence and innovation. Goldstein[3] highlighted that the kind of focus was still in its "infancy' and would progress through "cross- and multi-disciplinarity".

Alstyne and Logan[4] quip that "design", that is the mechanical activity within innovation, whilst important, is not adequate to guarantee success of the process. They suggest a need to consider emergence in the innovation scheme.

The objective of this research is to expose the role of complexity and, especially, emergence theories in organisational innovation processes using select literature analysis.

[3] Goldstein, 2005.

[4] Van Alstyne and Logan, 2007

There appears to be some complexity in the innovation process as brought out by a study of certain complexity theories discussed in this chapter[5]. Although Weick, Boisot and Snowden are discussing separate complexity theory subjects, they are addressing dimensions of innovation.

The critical activity in this study will be an exploration of complexity and emergence in existing literature and test whether these notions are useful concepts for understanding innovation. An important question will be to consider whether emergence can be a basis for modelling of innovation. Emergence, appears to be a suitable theory for innovation but is not a notion that is as commonplace or of renown as is innovation. Therefore, the thesis seeks to revisit the technical meaning of emergence in systems literature and then to relate it to the ways in which the concept is characterises organisational innovation.

It will be worthwhile to make a beneficial proposal on how emergence relates to innovation. Organisations should be concerned about the role complexity and emergence influence their innovation processes. Business operating environments are exposed to the influence of a multitude of factors. These act as networks that shape and influence internal processes. Organisation is increasingly about recognising how both external and internal networks shape products and services. It is surprising that some enterprises still operate in ignorance of this reality. Innovation processes are seen in most establishments as isolated from complexity. Some studies, which motivated the focus of this thesis, have a different perception and seek to establish a connection between emergence, creativity and innovation.[6]

These realities are justification for a study such as this one.

This chapter will introduce the key notions in this study, namely complexity, emergence and innovation.

Three theories will aid in the introduction of complexity and their discussions are in Sections 1.2 to 1.5 below. It is necessary to explain complexity, the "overriding" notion. It will be briefly clarified why complexity is such a critical subject in modern day analysis of organisation.

Although a chapter is dedicated to the analysis of a text on emergence, that notion will be introduced in Section 1.6. That section will locate emergence as an important theme in complexity. Secondly it aims to develop a case on why emergence is a viable notion for the explanation of innovation.

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[5] See Sections 1.3, 1.4 and 1.5

[6] For example, Goldstein, 2005

Innovation, dealt with using several theories in Chapter 2 in greater detail, will be introduced in Section 1.7. The starting point is therefore the "target", innovation, before a discussion on emergence. This requires some clarification. Innovation is the notion we seek to enrich, and emergence is the notion that will be explored and considered as a form of explaining innovation.

It should be clarified that this study will not claim that innovation is a part of emergence nor that innovation is like emergence. The first is a description of one being a subset and the second, a description of likeness. Both assertions, justified or not, are not our concern. The idea is to consider emergence within the processes of innovation.

This should primarily demand a description of both innovation and emergence. Chapters 2 and 3 are therefore necessary and essential activities in this exercise as they describe, using selected theories, innovation and emergence.

In Chapter 3 the position will be to present emergence as having a wide implication that also extends to innovation.

1.2 Complexity

The Newtonian approach to phenomena has dominated intellectual analysis. The tendency has been to regard all phenomena as in the mechanical dimension and work out results and consequences based on physical laws[7] only. Physical, social and organisational systems have been analysed in this way for a long time. This is also called reductionism.

Reductionism is a philosophical position assumes that the whole of a complex entity can be reduced to its constituent parts and that analysis is the appropriate method for understanding phenomena. It is a belief that wholes can be broken down for analysis.

The specific area of interest for inquiry has been the organisation[8]. In these settings, multiple systems are observable and create fertile complexity conditions. Morgan[9] identifies several metaphors in his description of "organisation". His "organisation" appears, interestingly, as in the verb-form. Remarkably, and worth drawing attention in this study, is his depiction of the machine metaphor alongside other metaphors. The machine metaphor typifies, for our purpose, the regard of phenomena in a mechanical sense. Morgan views organisations as

[7] For example, the law of gravity, the law of motion and so on.

[8] We must resolve it early that this is not only about the profit-making enterprise. It is also the social, educational or not-for-profit enterprise.

[9] Morgan, 1997

systems in his concept of metaphors. It mechanical view 'reduces' organisational participants and activities into simple forms comparable to machine parts. Examples of this concept are the structure of governments, the configuration of production processes, studies of nutrition, the set-up of security systems, military establishments and many others.

A growing number of modern scholars are starting to discover the difficulty of maintaining this form of reductionist analysis for all phenomena. It is certainly difficult to apply to the social entities that dominate most areas of how our lives are organised. Other depictions of organisation illustrate, and perhaps fit, the complex nature of organisations. This is not to say the mechanical view should be discarded as a standpoint. It demonstrates reductionist notions suitable in certain, but limited in other, areas of study or functions. Systems (fitting reductionist perception) are mostly "hard"[10] in nature and enjoy the old structured view. The view with brighter prospects is that of perceiving organisations as complex systems. Studies about complex systems are grouped under a body of knowledge generally known as "Complexity Theory"[11], which is the theory that informs this thesis.

The most important observation from the foregoing would be to point out simultaneous, near chaotic, existence of systems in even the smallest of sectors in most organisational settings. The conditions surrounding activities for the achievement of organisational missions, goals, strategies and objectives are a melting-pot of systems that complexly shape outcomes. They are composite. An illustration[12]of a complex adaptive system[13] is shown in *Figure 1*.

[10] Used in this thesis to mean what is related to technology of physics or engineering and opposed to "soft".

[11] Jackson MC, 2003 p. 11

[12] Hakimi, 2010

[13] Complex Adaptive Systems (CAS). The alternative name for complex systems bearing also the "adaptive" adjective in the name. They are "adaptive" because they are dynamic.

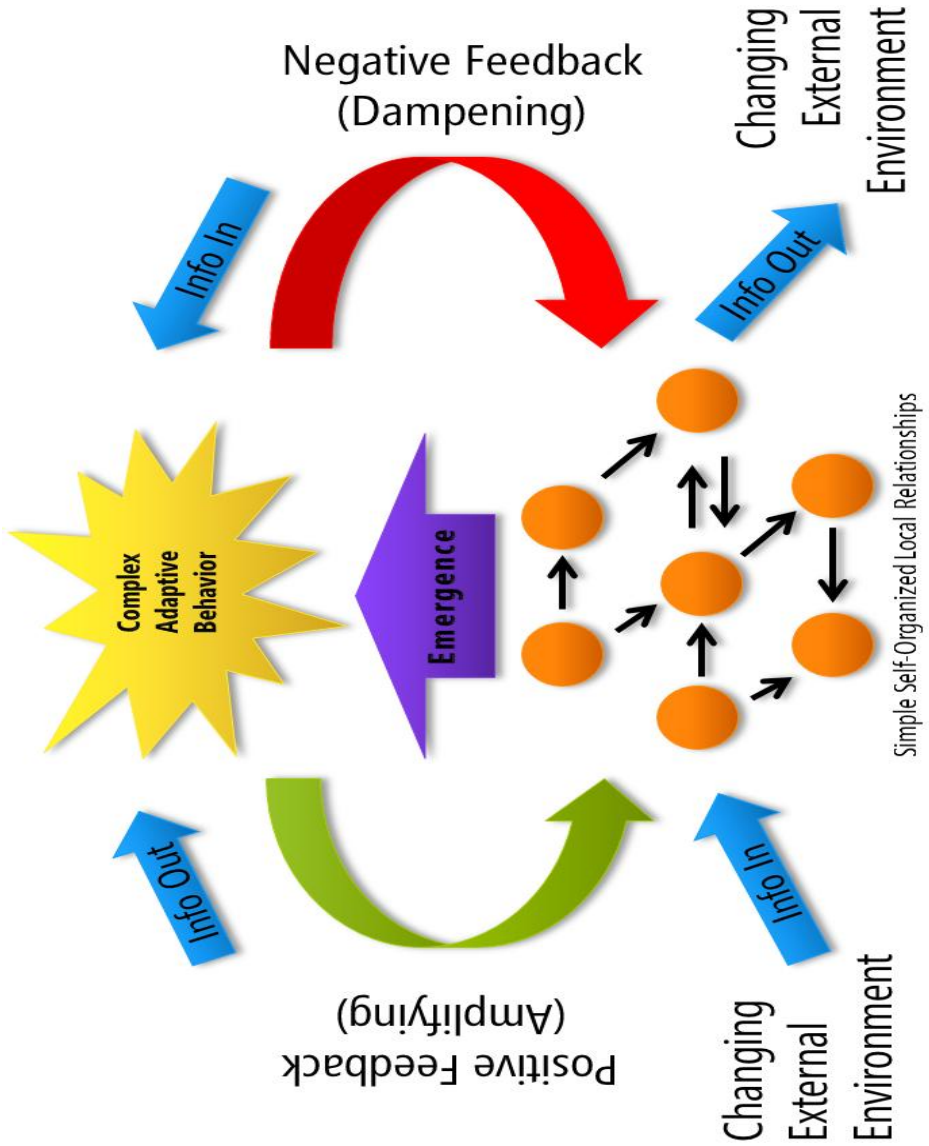

Figure 1. Depiction of Complexity / Complex Adaptive System[14]

The illustration in *Figure 1* shows how complexity systems or complex adaptive systems function. There is a feedback loop (seen in the arrows "Info In" and "Info Out"). The behaviour of the system is related to the environment (which is itself changing and continuously affecting the system). The parts of the system are "Simple Self-Organised Local Relationships" which have "emergence" as a distinguishing characteristic.

Most depictions of complex systems have much in common with Morgan's[15] "organism" metaphor. The themes below are common in complex systems and the "organism" metaphor:

[14] Hakimi, 2010

[15] Morgan, 1997

1. Adaptation – change is guaranteed and related to the environment
2. Open nature – external factors have a bearing on what happens in the system
3. Variety – there are multiple entities and systems in interaction
4. Ecology – the entities depend and determine each other's behaviour
5. Significance of the environment – what happens outside the system has a remarkable influence on internal factors

Our interest is about complexity in this study is around its creative nature. In this introduction, the focus is to explain this creative nature of complexity by dealing with a sample of theories that will prime our discussion on two subjects, namely innovation and emergence. Weick, Boisot and Snowden, in their organisational theories on sensemaking, the "Information Space" (or the I-Space) and the Cynefin Model all bring out the notion of complexity and point out aspects related to its creativity.

1.3 Weick's Enactive of Sensible Environments

The concept of "environment" listed above is discussed here in relation to Weick's[16] "enactive of sensible environments" that he points out to be a property of sensemaking and explains himself thus

> *...sensemaking better explains how entities get there in the first place... I use the term enactment to preserve the fact that, in organizational life, people often produce part of the environment they face.*[17]

He goes on to state how people act to create new features of the environment that did not exist before. Weick quoting Follet also claims that "...there is no result of process but only a moment in process."[18] Also, quoting Heider, Weick says *"*it takes a complex sensing system to register and regulate a complex object."[19] Further he also says that "[i]f people have multiple identities and deal with multiple realities, why should we expect them to be ontological purists?[20] This discounting of ontological purity in social and organisational systems is an embrace of complexity inherent in such systems.

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[16] Weick, 1995

[17] Weick, 1995 p. 30

[18] Weick, 1995 p. 33

[19] Weick, 1995 p. 34 - 35

[20] Weick, 1995 p. 35

Weick warns of Cartesian[21] anxiety:

> *...the idea that there is a world with pre-given ideas or ready-made (sic) information... (accept) that 'groundlessness is the very condition for the richly textured and interdependent world of human experience... [the world is not fixed and pre-given but] continually shaped by the types of actions we engage' Varela et al.*[22]

In a way, this concept of Weick's is an emphasis of the themes of relatedness and combination. The critical aspect of it is the consequence inherent in "enaction" (and indeed) sensemaking is creation, because "[p]eople create their environments and those environments creates them."[23]

Whilst Weick's theory is concerned with this relatedness of aspects in the organisation and how they in turn determine actions and meaning, Boisot handles the "movement" of information in the organisation and how it translates to and as value.

[21] Relating to the theory and philosophy of René Descartes.

[22] Weick, 1995 p. 37 - 38

[23] Weick, 1995 p. 34

1.4 Boisot's I-Space

The Boisot's description of his I-Space[24] has elements within it that clearly draw it closer to complexity theory notions. Boisot's I-Space may be explored to explain innovation, complexity and slight emergence elements. There is an introduction of both innovation and emergence later in this chapter.

Boisot's theory of the I-Space[25] is an explanation of the dynamics of information and knowledge flows within an organisation. It is a theory that analyses the nature and processes around knowledge assets within what Boisot calls the Social Learning Cycle[26]. Knowledge assets are "...stocks of knowledge from which services are expected to flow for a period of time that may be hard to specify in advance."[27]

In describing knowledge assets this way, Boisot also points out that the specific way these assets will behave in future is not known beforehand. This signifies a non-linearity in the behaviour of knowledge assets. They are also described as "complex configurations of interrelated elements."[28] This description of knowledge assets conjures up a description of this organisational aspect in systems terms. Further,

> *Since a firm's knowledge assets are more broadly defined than its technologies, their identification poses delicate problems, exacerbated by the particular way they evolve over time.*[29]

Identification of knowledge assets is complex and the same cannot be said about mechanistic processes that tend to obey a reductionists characterisation. Knowledge assets also *evolve* with the passage of time. In Boisot's words they have a "dynamic evolution"[30]

Knowledge assets are "stock" because they yield returns in much the same way as physical assets. They have value and are emergent. In Boisot's words: "Extracting value from knowledge assets requires an ability to manage them as they emerge."[31] There is a unique

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[24] Boisot, 1998

[25] Boisot, 1998

[26] In summary, this cycle traces value addition to information or knowledge as diffused, undiffused, abstract or concrete.

[27] Boisot, 1998 p. 3.

[28] Boisot, 1998 p. 64.

[29] Boisot, 1998 p. 42.

[30] Boisot, 1998 p. 58.

[31] Boisot, 1998 p 70.

management form that is suggested by Boisot on knowledge assets. It is not proactive but one that is concurrent with the dynamics and status of the phenomena *as "*(it) emerges." The value of knowledge assets has a complex quality, because "[v]alue in the I-Space is...inherently unstable."[32]

Instability has an association with risk. Risk, in economic terms, may easily translate to high returns or deep losses depending on how they are managed. The recommendation by Boisot to manage knowledge assets as they emerge enables the realisation of connections and the management of instability. Unstable economic phenomena normally warrant close monitoring.

Boisot's argument is that knowledge assets are "within"[33] the organisation's employees or members amongst other entities. How they are perceived, used and handled is dependent on the placement of the individual. Commenting on this phenomenon, Boisot, points this out about management's action in this process,

> *Using simple scales they are usually able to rate without... the degree of codification, abstraction, and diffusion of their firm's products, technologies, and organizational elements. They first do this individually, reaching consensus iteratively through discussion.*[34]

Different diffusion scales, for example, can be used to represent, respectively, employees within department. Consensus itself is a product or creation. It is the result of a process. Snowden, below, explores the complexity in managing knowledge in his model showing four quadrants with different kinds of order and a fifth zone of disorder in the centre.

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[32] Boisot, 1998 p. 81.

[33] This is an expedient preposition. It does not fully address the scope of the concept.

[34] Boisot, 1998 p. 64.

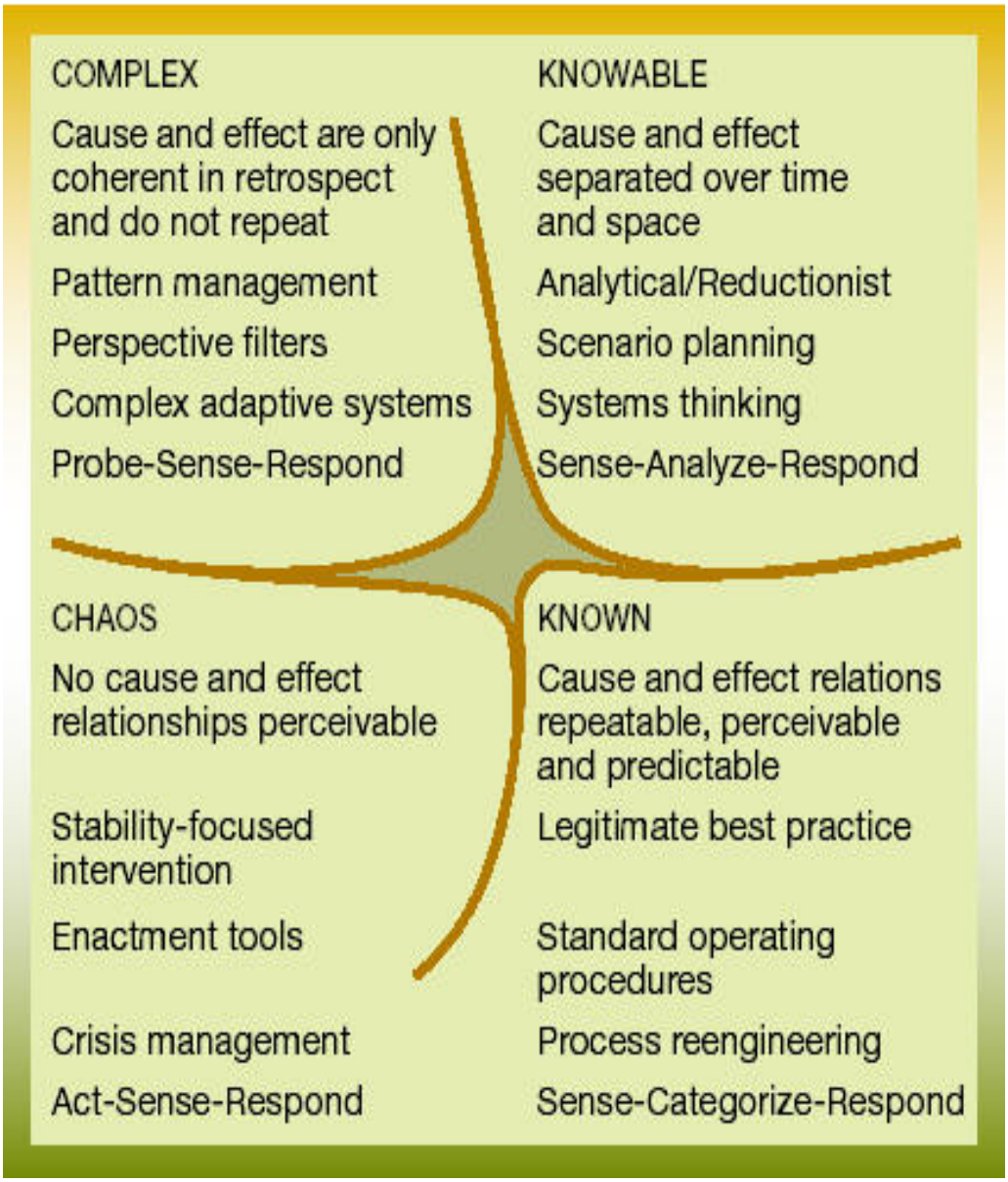

Figure 2. Cynefin Model[35]

[35] Lal Patary, 2015

1.5 Snowden's Cynefin Model – Complexity in Managing Knowledge

Crutchfield noted that:

> *If a system is chaotic, how chaotic is it? A measure of chaos is the ''entropy'' of the motion, which roughly speaking is the average rate of stretching and folding, or the average rate at which information is produced*[36]

The edge of chaos[37] is a zone of high disturbance and collision along the border between order and chaos. This disturbance, though bearing qualities that may seem erratic, is beneficial, because it holds the promise of new patterns of organised complexity. In the Cynefin Model[38], Snowden presents a model for knowledge systems with four zones: Chaos, Complex, Knowable and Known. What he calls Cynefin dynamics is the various movements and transformations between these four zones of various kinds of order. Brainstorming, analysis and most activities that seek to unpack and break down or define a challenge are in the dimension of the Knowable. Once there is reasonable information about a challenge, interventions, strategies, procedures and implementation of changes that are effected to fit into the dimension of the Known. The clutter of phenomena or information at the chaos stage is chaotic but not random. It may appear to be random to observers, but Snowden does not see chaos as equivalent to disorder; instead the zone of disorder has a category of its own in the centre of the Cynefin model. Chaos emanates from the abundance of data, information and other factors. Chaos is associated with lack of clarity from the point of view of an observer. It is a result of previous processes, but it is also a start. Because it is start, it holds the promise of new patterns emerging that could be stabilized and moved into the Complex zone for instance.

Snowden, commenting about knowledge systems, says this about the scenario that

> *...we never start from a zero base when we design a knowledge system, all players in that system come with the baggage, positive and negative derived from multiple histories.*[39]

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[36] James P. Crutchfield, J. Doyne Farmer, Norman H. Packard, and Robert S. Shaw, Chaos, edited by Mark A. Bedau and Paul Humphreys 2008 Emergence: Contemporary Readings in Philosophy and Science, The MIT Press, London

[37] In this text, it is understood to mean the characteristic of complex systems implying the existing of seemingly unrelated phenomena working towards a state that is not surprisingly non-linear or unpredictable in.

[38] Snowden, 2002

[39] Snowden, 2002

At the start[40] there is discord in the arrangement of the units in the system. There is no certainty about what has benefit or does not have. The units draw from other processes they have been a part of or are still a part of. It is perhaps impossible for only one entity to exist alone and as the only factor in any zone or scene. The other significant point is the diversity in the initial set-up or chaotic zone. Snowden remarks about patterns and logic in the system with respect to time.

> *A feature of a complex system is the phenomenon of retrospective coherence in which the current state of affairs always makes logical sense, but only when we look backwards. The current pattern is logical, but is only one of many patterns that could have formed, any one of which would be equally logical.*

The status quo is sensibly explained by a sequence of events leading up to it. At the time, each took place, there was no means of working out that they would have culminated to the present format of phenomena. A range of possibilities had an opportunity to form and only after patterns formed can they be "managed" by either trying to stabilise or disrupt them. Of course, disruption does not guarantee that a desirable new pattern will form. There is little room to use the present situation to predict probable future scenarios. The best way to "manage" the situation, if there is need, is to focus on relationships between elements and to heed the formation of patterns as they occur.

> *The nature of the Complex domain is the management of patterns. We need to identify the early signs of a pattern forming and disrupt those we find undesirable while stabilising those we want. If we are really clever then we seed the space to encourage the formation of patterns that we can control.*[41]

To point out the requirement for cleverness and the need for prompt diagnosis of relationships and patterns appeals to the rapid rate of change within the system. Viewed closer, the proposal, in managing within the complex zone or complexity, is to not focus on traditional factors like individual parts. It is assumed ideal to focus on the system and see the patterns formed by the interactions between the individual parts scheme.

The complex zone is an information-rich zone. This brings our discussion to Weick's[42] regard of information. His scenario is one that is characterised by many possible messages

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[40] There is a misleading notion about this. "Start" assumes a beginning and an end in the process. A point stressed in this thesis, and indeed a theme in complex systems is the non-existence of commencement or terminal points. It is only for academic purposes that a starting point must be located.

[41] Snowden, 2002

[42] Weick, 1995

that can be plausibly constructed from a flow of stimuli that are selected and framed by observers as cues. Weick recognises the response to a complex situation as "shock"[43] requiring the imposition of a frame on the overload of information to filter what is sensible. A contrasting situation is one where there are not enough cues available in information-scarce environments, which he calls conditions of "uncertainty" needing a widening of the frame or better search to include more cues. However, in complex environments the problem is too much information, Weick says they demand a certain form of information management. Rather than focus on the amount of information, management in complexity and ambiguity rather requires an improvement in the form and quality of the information. Information richness, therefore, does not necessarily mean the existence of sense, instead it increases the burden on the framing activity of the sensemaker. Snowden realises the requirement for a different form of management under these conditions:

> *These patterns are, to use the language of complex adaptive systems theory, emergent properties of the interactions of the various agents. By increasing information flow, variety and "connectiveness" either singly or in combination we can break down existing patterns and create the conditions under which new patterns will emerge, although the nature of emergence is not predictable.*[44]

The preceding discussion on complexity enables us to move onto emergence, the phenomenon in focus. Emergence was highlighted in being a key marker of complexity in the explanation of *Figure 1*. It is suggested when Weick accounts for Follet and Heider's views in dispelling predictability in organisational interactions and traces an interaction in how creativity plays out for both human and environmental elements with organisations. Boisot points out the emergence of knowledge assets. Snowden implies emergence in discussing his Cynefin Model. As can be seen, these organisation and management gurus consider it necessary to manage by the dictates of the dynamism of emergence.

[43] Weick, 1995 p. 91 - 105

[44] Snowden, 2002

1.6 Introduction to Emergence

Emergence, a key marker of complex systems, is a core phenomenon in the universe. It is not a rule but is the manifestation or consequence of the rules of interactions between parts in our universe. Christen and Franklin[45] , title their piece "The Concept of Emergence in Complexity Science". It is crucial to separate the term "emergence" as used in complexity sciences from the lay use of the term. The common connotation of the lay usage of the term, distinct from its desired application in this thesis, is frequently used in biological and social sciences and relates to notions of coming out of a space, concealment or surfacing into the open. Some authors[46],point out the difficulty in defining emergence[47]. Damper[48], for example, concedes to the difficulty in defining the term "emergence" by saying that, "[i]t should be obvious from the foregoing discussion that the term emergence does not easily admit of a precise definition." But Goldstein[49] gives a more confident definition, saying that emergence refers to "the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems." He goes on further to say that "emergence refers to the sudden arising of new patterns and structures possessing new properties".[50]

Not all systems are emergent, because the condition for emergence is complexity—a matter introduced in Section 1.5. Emergence is a feature of complex systems. Goldstein[51] states five characteristics of emergent phenomena. The first he points out is that of "radical novelty"[52]. Emergent phenomena manifest features that were not previously observed in the system. It is, and deceivingly so, as if these features have no relatedness to the system. Secondly, there is "coherence or correlation"[53] in the system. There is relatedness over time (horizontally) and at specific points in time (vertically). The existence and state of each part of the system can

[45] Christen and Franklin, 2002

[46] For example, Damper, 2010 and Hempel and Oppenheim, 2008

[47] Christen and Franklin, 2002

[48] Damper, 2010

[49] Goldstein,1999

[50] Goldstein,1999

[51] Goldstein,1999

[52] Goldstein,1999

[53] Goldstein,1999

be explained about the other parts. There are integrated wholes that maintain their relationship over some period. The third characteristic is that a "global" or "macrolevel"[54] can be identified. There is a property of wholeness when all the parts are considered together. There is some significance when the parts of the system are considered together. That the system is a "product of a dynamical process"[55] is the fourth characteristic. The system exhibits a state at a time and is in a perpetual process. It is in flux and not stable. Lastly, Goldstein says that the emergent system is "ostensive"[56]. This means emergence is perceivable in its states.

Morgan's[57]explains emergence (or "emergent evolution") as the "creation of new properties."[58] In his definition, there are three key words: "properties", "new" and "creation". By a more detailed discussion of these key concepts, it is possible to grasp the primary topics in the concept of emergence.

To quote Hempel and Oppenheim,

> *Generally speaking, the concept of emergence has been used to characterize certain phenomena as ''novel,'' and this not merely in the psychological sense of being unexpected, but in the theoretical sense of being unexplainable, or unpredictable, on the basis of information concerning the spatial parts or other constituents of the systems in which the phenomena occur, and which in this context are often referred to as ''wholes.''*[59]

[54] Goldstein,1999

[55] Goldstein,1999

[56] Goldstein,1999

[57] Morgan L, 1922

[58] Emmeche et al, 1997

[59] Hempel and Oppenheim, 2008

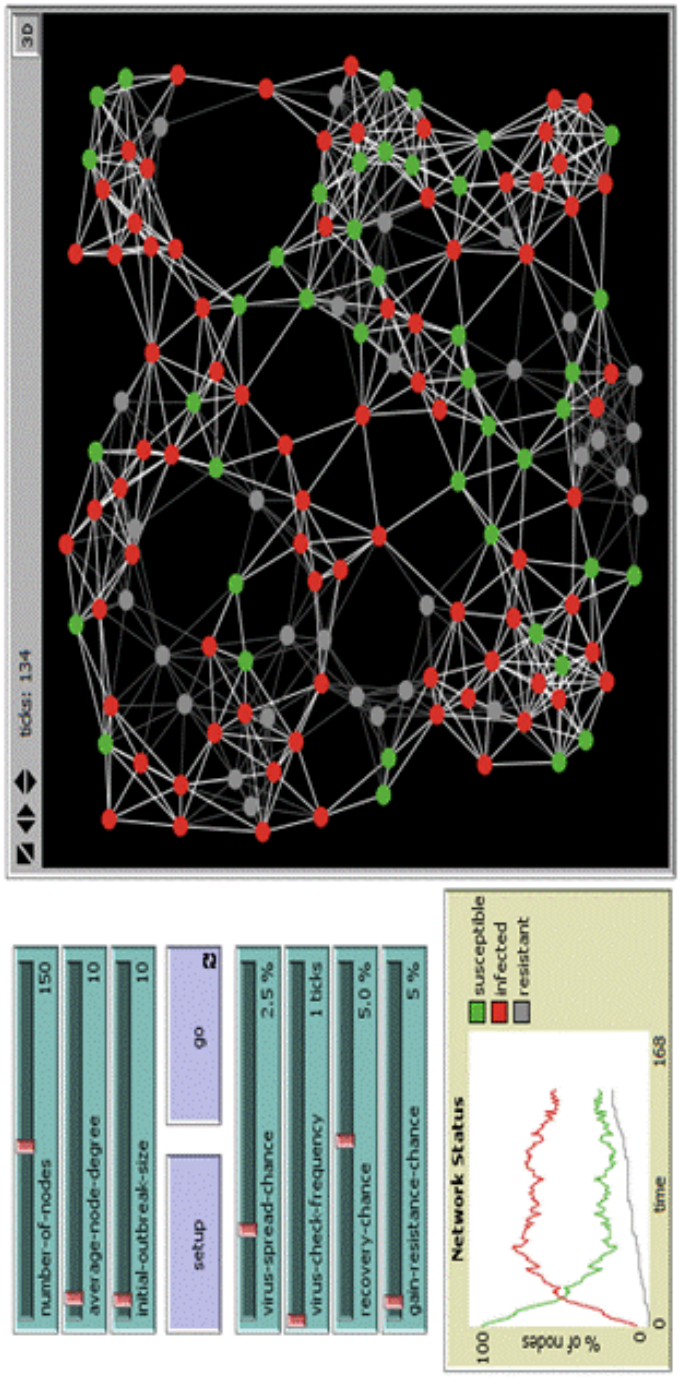

Figure 3. Depiction of Emergence (stopped at 5.28 seconds)[60]

[60] NetLogo Version 5.0.3, Wilensy, 1999

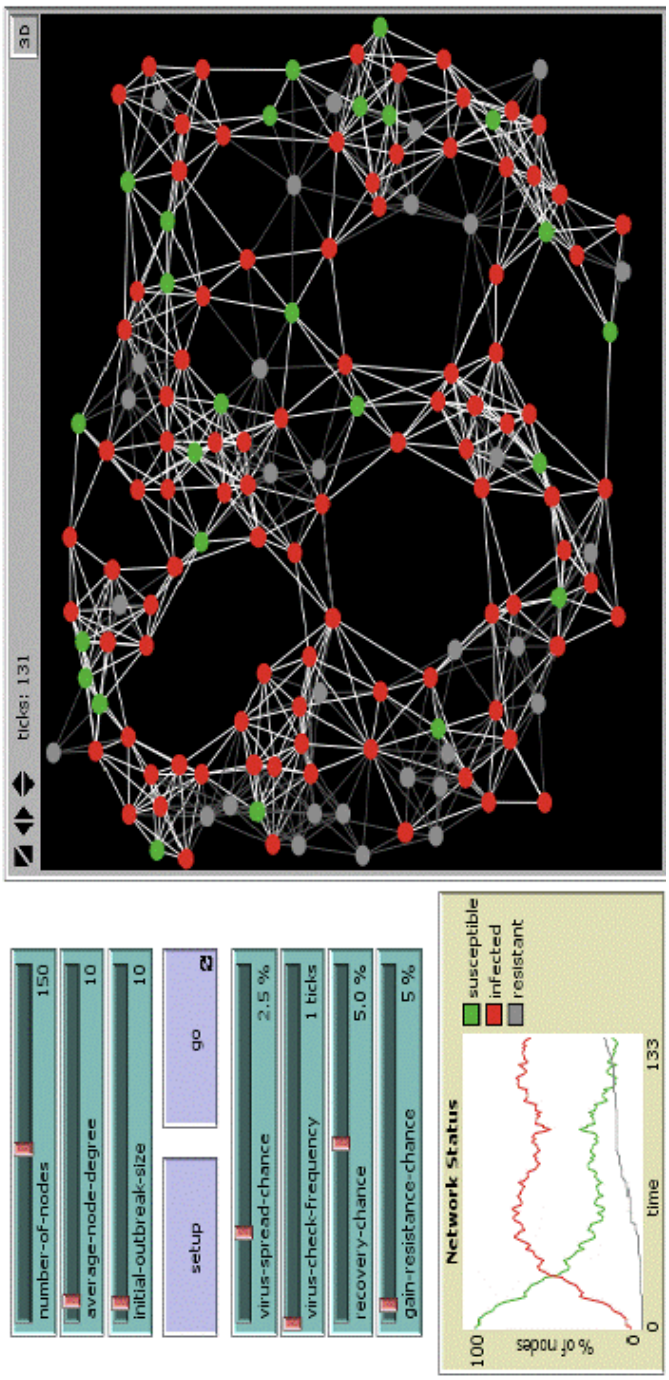

Figure 4. Depiction of Emergence (NetLogo stopped at 5.31seconds)[61]

[61] NetLogo Version 5.0.3, Wilensy, 1999

A conceptualisation of emergence in diagrammatic forms using "NetLogo"[62] is seen in the illustrations. It is observed that despite there being little variance in the initial input/setting, the outcome (i.e. the pattern on the screen) is different. The two images on the black screen manifest format and infection variations even though local relationships' (number of nodes, average-node-degrees and initial-outbreak-size[63]) settings are the same in Figure 3 and Figure 4. The fundamental observation that is learnt from it is that even if a designer is absent in a system, some order can still emerge from chaos. What is required are certain initial conditions, and rules in the system to regulate the interaction between elements.

Chapter 3 explores the topic of emergence in greater detail than has been done here. For now, the contribution to our discussion on complexity by Weick, Boisot and Snowden's theories was from an organisational perspective. It is still possible to extend these theories to other perspectives. Importantly, all theorists attribute a significant role of emergence and its creative nature. Emergence is a creative force that might be considered as explanation for innovation. Section 1.7, below, introduces innovation.

1.7 Innovation in Brief

Innovation is a central theme in the knowledge economy[64]. The theme of innovation is implicit in most knowledge management activities and exercises. Innovation is perennial problem in knowledge management, because existing already codified knowledge conceivably only needs information management, however the creation of new knowledge demands an innovation perspective of sorts.

In Sections 1.4 and 1.5, there were discussions on how organisation and management writers invoke complexity and emergence as a zone of creativity and newness and the question is how innovation relates to complexity and emergence.

The World Bank[65] identified "effective" and "efficient" innovation as an important pillar in the knowledge economy.

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[62] NetLogo Version 5.0.3, Wilensy, 1999

[63] The model used in the example tests the outbreak of a virus. Nodes represent the population coloured appropriately to indicate those susceptible, those infected and those with a resistance to the virus. It was impractical to stop the ticks (in this NetLogo example, the quantity of ticks is directly related to time) on exactly an equal number, but an attempt was made to get the almost same ticks to provide a relevant example.

[64] Used in this study to mean the prominent determination by intellectual property and knowledge of business and organisation effectiveness and competitiveness and, alternatively, the scenario within which this occurs.

[65] World Bank, 2003

> *An efficient innovation system of firms, research centers, universities, consultants, and other organizations to tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology.*[66]

A more comprehensive discussion on innovation will be made in Chapter 2. The connotation of innovation with creativity will suffice in this introduction. Franken[67] describes creativity as "...the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others."

It is inevitable to exclude creativity when one discusses innovation, because without the creative process, there are no new ideas to be turned into innovations manifested in either tangible or intangible[68] artefacts of value.

1.8 Study Format

1. How complex is innovation? This work attempts to define innovation and posit it, before any analysis, as a complex notion. Is it possible to draw from other theories and extend our understanding of innovation? This is the subject of Chapter 2.

   Chapter 2 explores innovation in an overview. It is a broad topic and our treatment of it will therefore be a synopsis of its description. The discussion will focus on those concepts that enable us to analyse it within Complexity Theory.

2. What is Emmeche et al's[69] perspective on emergence? The authors of the thesis that will be analysed in Chapter 3 offer a multiplicity of interesting views and present this as their epistemology on emergence. Chapter 3 is dedicated to expose their explanation of emergence from several angles.

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[66] World Bank, 2003

[67] Franken, 1993

[68] The notion of the value of intangible assets is explained by Boisot in the same theory of the I-Space discussed earlier.

[69] Emmeche et al, 1997

3. Chapter 3 addresses cardinal notions of emergence according to Emmeche et al[70]. It will be explained that Emmeche et al's theory pivots on that of Morgan who addressed emergence as "emergent evolution". It is foundational that Emmeche et al. regard emergence as a credible framework for a wide range of processes. It underpins our discussion in this thesis. Several views of what emergence is, according to Emmeche et al, are provided and developed. It becomes apparent that, in their theory, emergence must be opened to various perspectives and descriptions.

   This central text on emergence particularly selected for our analysis, that of Emmeche et al., explains emergence from a pluralist point of view. That plurality in their approach appeals to a motif in this project evident in the framing of all the four chapters from heterogeneous resources. Emmeche et al's treatment of emergence condenses the arguments of old and new voices on the subject.

4. What are the themes that can be formed from the review of innovation theories and the discussion emergence based on Emmeche et al's thesis? We will deal with these as individual themes in Chapter 4 as we enhance innovation theory.

5. What is the assessment of emergence in the innovation process? Chapter 5 concludes the discussion by offering some views and justifying a position that exploits acknowledges the role of emergence in a phase in innovation.

[70] Emmeche et al, 1997

1.9 Conclusion

Boisot's[71] I-Space significantly benefits our explanation of innovation and complexity. In this chapter, insights into Boisot's theory were used in the explanation of facets of the Complexity Theory as were Snowden's[72] on the Cynefin Model[73].

Two tenets of Weick's[74] sensemaking theory, are brought into our discussion in both this chapter and the second. This chapter explored his "enactive of sensible environment"[75] property in a description of complexity.

Weick's other contribution, on social creation, is beneficial to the conversation on innovation in Chapter 2.

Dey's[76] "enablers" of innovation appear to facilitate a complexity view of innovation. There may be other classifications of "enablers" available in other literature other than Dey's but Dey's scope has fair coverage. "Enablers" may fit the description of what some other writer may call "factors".

One other theorists selected in the presentation of innovation is Holland[77]. His discussion on emergence weaves-in notions of innovation and emergence. This is doubly significant to a discussion such as the one here where one concept is being presented considered as a model another.

Rogers et al's[78] Diffusion of Innovation Model is central to this thesis as it enables us to transcend the limits of the traditional treatment of innovation and facilitates a clear view of innovation's complexity whilst priming the discussion for the synthesis of concepts in Chapter 4. The perspective of Rogers et al complement those of Dey's in and assesses innovation's consumer's. Suffice to it perceives the contribution of consumers and their role in innovation.

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[71] Boisot, 1998

[72] Snowden, 2002

[73] Gladwell, 2000

[74] Weick, 1995

[75] Weick, 1995.p. 30

[76] Dey, 2012

[77] Holland, 1998

[78] Rogers et al, 2004

The theory on emergence is broken down into several themes, each discussed in turn and primed for assessment with Chapter 2 concepts in Chapter 4. This chapter begins to create an anticipation of the themes that feature in Chapter 4. The criticality of the notion of supervenience in the emergence debate, hopefully, is also addressed in this chapter.
We started this chapter by stating the purpose of this study. The discussed the complexity theory and emergence. It extended this to Weick, Boisot and Snowden whose perspectives focus on complexity, emergence and the management of information, knowledge, and the environment. This was followed by a brief introduction of innovation and its association with creativity. This chapter also featured a discussion on creativity and its relationship to emergence. Chapter 2 will provide an overview of innovation and discuss it using different theories

Chapter 2
Innovation: An Overview

2.1 Introduction

A major theme in this thesis is to contribute to innovation theory, since there are many different conceptions of innovation, we need a working description of the type of innovation well primed for the discussion we target to have in Chapter 4. There are many perspectives on innovation at various levels of analysis. An attempt is made here to provide an overview of innovation literature from various perspectives in order to analyse it in complexity terms. Theories, like those of Chesbrough, Dey, Holland and Weick have been selected as representative ones to use in this exercise.

The first section will use Dey's[79] views on how innovation can be classified into five types. It will be summarised, after adding Dershin's[80] insights, how these types of innovation qualify for analysis in complexity terms. The next focus, following through on Dey[81], is to discuss the enablers of innovation. These are factors that make innovation happen or speeds it in organisation. Other insights, including Doss'[82] will contribute to some clarity in that section. Holland's[83] deals with a description of an innovation process. Holland places attention on metaphor. It is the first of three that are included in this chapter. The others are Chesbrough's[84] Open Innovation and Weick's[85] Social Creation.

The final discuss will be on the Diffusion of Innovation Model (DIM)[86]. It must be clarified that the DIM is not a comprehensive description of the innovation process. The model functions to analyse the spread of novel ideas. Discussing the DIM is an attempt to analyse

[79] Dey, 2012

[80] Dershin, 2011

[81] Dey, 2009

[82] Doss, 2013

[83] Holland, 1998

[84] Chesbrough, 2006

[85] Weick, 1995

[86] Rogers et al, 2004

how customers interact with an innovation or new product. Rogers et al describe the DIM as follows,

> *... (it) is concerned with change occurring among human agents or nodes in an interconnected network of communications, yet it can easily incorporate nonhuman intervention devices such as mass media or electronic technology as reactive agents (with reactivity defined as sensitivity to change)*[87].

One may debate that a certain tenet of the DIM, scaling, is metaphoric of the innovation process.

2.2 Types of Innovation

Dey[88] cites the diverse types of innovation below. These are dealt with below.

2.2.1 Product innovation

> *...new and better products that your organisation can provide to customers.*[89]

This is the most common conceptualisation of innovation. A new *product* is brought to the market as a new consumer attraction. It is brought onto the market to displace another by its more superior and desirable qualities.

2.2.2 Service innovation

> *...new and better service offerings and delivery of those services to customers.*[90]

This is related to the first type but applies to businesses that offer services as opposed to products[91]. In the knowledge economy, there is a growing market for services. More and more millionaires are being made from knowledge-based businesses.

2.2.3 Process innovation

> *...better ways of doing things that save time and/or money.*[92]

Henry Ford did not invent the car, he innovated the car-manufacturing process by introducing the assembly line in the manufacturing of the Ford Model T. Innovating business processes leads to better efficiency in production process or service delivery. This normally leads to

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[87] Rogers et al, 2004

[88] Dey, 2012

[89] Dey, 2012

[90] Dey, 2012

[91] In a sense, an offered "service" is regarded, in commercial terms, as being a "product" as well

[92] Dey, 2012

gains by the organisation in the reduction of production costs and time. The best process innovation ultimately results in better cost for quality to the customer.

2.2.4 Business model innovation

> *...improving the way your organisation creates, delivers and extracts value from customers.*[93]

This form of innovation entails a shift of focus in the business but requires foresight as to which product and services are likely to achieve the most gain in the medium to long term. It "is a specification describing how an organization fulfils its purpose"[94].

Descriptions of business model innovation by some sources, because they seem to address broader organisation aspects, appear to fit those for strategy. The difference seems to be the limitation of business model innovation to business, in other words, the relationship between customers and value[95].

Dey's view is very similar to Drucker's quoted here[96] saying

> *...a business model answers the following questions: Who is your customer, what does the customer value and how do you deliver value at an appropriate cost?*

The questions have answers that are dynamic. This is so since the customers, their values and modes of value delivery are dynamic phenomena. So, innovating a business model is an on-going "exercise"[97].

Google is an example[98] of a company that benefitted from business model innovation

> *In 2003, the company launched its AdWords program which allowed businesses to advertise to people searching for things on Google.com. Almost overnight, Google took the leap from popular search tool to advertising juggernaut.*

The tool, Google.com, change very little but extended itself from being an internet search tool to being also an advertising platform.

2.2.5 Organisational innovation

> *...improving the way you manage and engage your employees.*[99]

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[93] Dey, 2012

[94] Rouse, 2013

[95] The theme of "value" is explored in latter chapters and exposed as critical to the notion of innovation.

[96] Rouse, 2013

[97] The word "exercise" offers the closest description but is itself not precise as it implies programmed and conscious action. Business innovation involves unprogrammed and unconscious action too.

[98] Walley, 2010

[99] Dey, 2012

An illustration is Jack Welch's management approach that revolutionised management of people in organisations. He developed the concept of an organisation without boundaries. organisation. This involved the notion of removing hierarchical structures and viewing everyone in the organisation as a source of ideas.

In the same vein, Kaplan and Norton's Balanced Scorecard[100], that emerged as one of the most comprehensive and well-used organisational management tools, is an illustration of organisational innovation. Kaplan and Norton's ideas were useful in changing views about the way organisational objectives are communicated and monitored in organisations. This is a major contribution to strategy planning and implementation.

2.2.6 Brand and communication innovation

> *...new and better ways of representing your organisation.*[101]

This kind of innovation has marketing and/or publicity functions. The election of United States President Barack Obama in 2008 was preceded by innovative campaigning that used social media platforms.

> *Obama enjoyed a groundswell of support among, for lack of a better term, the Facebook generation. He will be the first occupant of the White House to have won a presidential election on the Web... This election was the first in which all candidates—presidential and congressional—attempted to connect directly with American voters via online social networking sites like Facebook and MySpace. It has even been called the "Facebook election." It is no coincidence that one of Obama's key strategists was 24-year-old Chris Hughes, a Facebook cofounder. It was Hughes who masterminded the Obama campaign's highly effective Web blitzkrieg—everything from social networking sites to podcasting and mobile messaging.*[102]

Brand and communication innovation appears to be a response to shifting communication medium preferences by the target group. It therefore capitalises on communication media and competences thereof and is complex.

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[100] Kaplan, 2010

[101] Dey, 2012

[102] Dutta and Fraser, 2008

Dershin[103] proposes managing innovation as a complex adaptive system from his conclusion that innovation is non-linear in nature and process:

> *The term 'complex' applies to innovation because of the unpredictability of outcomes, their dependence on initial conditions, and the powerful effect of interaction and feedback among many variables. 'Adaptive' applies because approaches to an innovation challenge shift and change over time as the system moves from one state of knowledge to another. 'System' is applicable because current thinking has progressed from viewing innovation as relying on the work of isolated sources to appreciating the interconnectedness of the various sources*

2.2.7 Summary

In summarising Dey and Dershin's insights above, it can be observed that innovation, in all its forms, is about improvement. The focus, each time, seems to be a target of the business' improvement of its delivery. This is evident in the assertion made regarding process innovation that innovation is worthwhile when it considers the quality cost to the customer. In discussing business model innovation, it was important to note the dynamism entailed in the process. The process, in its ideal practice, has no end. Awareness and input of the customer's perspective are also critical.

Brand and communication innovation is sensitive to the target group. This type of innovation must regard environmental changes and media at the disposal of, and preferred by, those that the organisation is targeting. In the knowledge economy, these media and technology evolve and can be disrupted.

Organisational innovation, even though it is about the organisation's employees, likewise demands an environmental focus and entails improvement. Employees' expectations will certainly not be static and responsive, in turn, to the environment employees exist in.

Dershin's remarks on the way to manage innovation will find credence in Dey's description of the type of innovation: innovation must be perceived as complex and non-linear. The complexity of innovation can initially be appreciated by discussing Dey's enablers of innovation. What Dey proposes as enablers are not exhaustive but what are included are sufficient to spell out innovation's complexity.

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[103] Dershin, 2011

2.3 Dey's Enablers of Innovation

The views from Dey provide a significant explanation of how, innovation, like most phenomena, will be influenced and determined by factors regarding its rate of progress or success. According to Dey[104], the factors below enable innovation.

2.3.1 Challenge

Bingham relates challenges to strategy and refers to how organisational objectives can be used to articulate them. He also endorses a "challenge culture"[105]. There are similarities between this culture and one that is critical of it and continuously questions why it carries out its activities in the manner it does. When objectives are outlined and reviewed periodically, organisations action must be aligned to them. This maintains dynamism in an organisation and an improved culture.

2.3.2 Leadership

The first critical observation to make in the opinion of Hill[106] is that innovation "is led". This implies some authoritative[107] guidance and support[108]. This involves long-term plans and clarifying important and critical organisation focus. Leadership manifests in strategy[109] amongst other organisational aspects. The depth of an organisation's innovation depends on how "the leader(ship) interacts and perceives innovation."[110]

2.3.3 Strategy

An organisation's strategy is espoused in its values, missions and visions. A strategy may prefer growth or consolidation. This means the organisation must adapt to its environment or attempt to influence its environment in an offensive or defensive manner in view of competition. Ultimately, strategy demands some form of innovation. In most cases,

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[104] Dey, 2009

[105] Bingham, 2012

[106] Hill, 2014

[107] There is a need to explain away the negative implication here of the word "authoritative". What is implied is guidance from designated organisational heads. Opinions in the previous discussion on freedom must be left intact. In fact, Hill notes that leadership in innovation must be perceived differently from other forms of leadership, for example in crises, the political and military forms and so on. She endorses that an "inverted hierarchy appears to be more effective".

[108] It is beyond the scope of this paper to explain "leadership". There are different views that have contributed to the topic. It is best described within specific circumstances and not confined to those who have oversight on others, managers and boards necessarily. It may suffice to explain "leadership" as more sustained and long-term than "management", less about control but involving the development, instilling and explanation of vision.

[109] See section 2.3.3

[110] Gumusluoglu and İlsev, 2009

innovation is either on methods or the organisation's product111. Strategy also determines the degree of this innovation through its influence on organisational focus and financing of action.

2.3.4 Culture

Culture refers to, "patterns for behaviour (sic) not patterns of behaviour (sic)"[112]. Culture is a pattern meant to be a framework for habits. It is a template within which behaviour is regarded as normal. Culture therefore has significant boundary effects on creative behaviour. It may affect both creativity and diffusion of innovation[113]. One source puts it remarkably when they make the revealing comment about culture that "the organizational culture acts as a filter through which strategies are defined and the performance determined."[114]

Also, Doss[115], states that three tenets of good organizational culture for innovation namely trust, diversity, and a proper attitude to risk: An important facet of an innovative culture is the amount of trust placed in organisational members to put forth ideas. Trust is built by the leadership and gives employees confidence to act freely. Trust enables creative thinking without the worry of retribution. It is promoted in an environment where leadership consider themselves as facilitators of innovation and creativity and not regularly in the forefront.

The observation by Dey on diversity is related to the identification of heterogeneity by Rogers et al. in the "Diffusion of Innovation Model" (DIM)[116]. The variation here is that Dey's focus is on the creative and development process.

> [It is diversity] *of people, points of view, ideas, ethics, and beliefs. It is axiomatic that innovation requires iteration, constant challenge, testing, playing, and randomness. Innovative organizations require leadership that values and welcomes diversity.*[117]

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[111] These are notions, albeit over-summarised, dealt with comprehensively by De Wit and Meyer (2010) under four broad strategic foci viz, process, content, context and purpose.

[112] Van Alstyne and Logan, 2007

[113] The diffusion of innovation is discussed in section 2.7.

[114] Gumusluoglu and İlsev, 2009

[115] Doss, 2013

[116] Rogers et al, 2004. DIM is discussed in detail in Section 2.7.

[117] Doss, 2013

The actions that Dey consider as axiomatic[118] are only possible with a sizeable and diverse-cultured group. In a way, Dey's remarks here extend Weick's ideas[119] in his sensemaking theory when he describes role of individuals in organisations in shaping realities.

It is often asserted that ventures that entail substantial risks often attract high returns. High return potential is what makes innovations attractive to funders. Trending world economic fundamentals dictated by globalisation are becoming more and more unstable and complex. The other dimension to locate risk, in another form, is within organisations and the atmosphere created for innovation. Since the creative process entails internal and non-customer related financial resources, the process can be likened to risk-taking, trial and error and failure. Dey clarifies the role of risk by saying:

> *Innovative organizations encourage risk, and understand failure. Without leadership that understands and contextualizes failure, risk will be a negative organizational value. Yet again, leadership is necessary, but insufficient... Where organizational systems link personal success to the absence of failure, there will be diminished risk taking.*

2.3.5 Corporate Processes/Standards

There are many ways of looking at corporate processes. Most corporate processes are about how data, information and knowledge are central in a business[120]. Figure 7 illustrates the role of data, information and knowledge in decision-making. The information and knowledge are more often, and in discerning organisations, captured and codified in:

1. Best practises – when the organisation commits to use optimum methods in their tasks.
2. Benchmarking – when the organisation sets objectives to be equivalent to a market leader's standards with the aim of even surpassing those standards
3. The basic principle of benchmarking consists of identifying a point of comparison, called the benchmark, against which everything else can be compared.[121]

[118] Interpreted to mean: being evident but without proof or evidence.

[119] Weick,1997. Explained in Chapter 1 and later in Section 2.6.

[120] French et al, 2009

[121] Ettorchi-Tardy et al, 2012

4. Standardisation – this often requires an organisation to meet the standards laid out in a "code of practise". Standards are often generic and apply to specific organisational functions like safety, quality, financial reporting and so forth.
5. Procedures – the organisation sets out "how-to" statements that must be adhered to in their work processes. They are set to ensure consistency and may be useful tools in benchmarking, standardisation and forth. Although these may result in sound organisation[122], they may become obstacles to innovation and mechanise[123]business activities and decision-making.

2.3.6 Finance

Finance is a resource that certainly determines the success or rate of innovation. Innovation requires finance and a model below indicates the stages at which various sources ideally intervene. The axis label "Cash Flow", also traces stages of development of the concept. In the discussion on the DIM in Section 2.7, the role of finance in innovation will also be highlighted. At times, innovations fail because of lack of money. This may happen even when they have a selling point and show excellent value potential. In summary, before mass adoption of an innovation, funding must be available to sustain the creative and development processes. Thereafter, and after mass adoption, innovation is sustained by adopters, or customers.

The "Start-up Life Cycle"[124] presents an opportunity to analyse, in graphic form, the role of financing in commercial innovation. Placed in this discussion, this presentation can be criticised for simplifying commercial innovation financing dynamics. They are certainly more complex and not too yielding to reductionist analysis. The representation should be accorded some credit for standing as a model to aiding our understanding of the various responses capital views novel ideas. It aids planning and strategy.

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[122] In the verb-sense

[123] Borrowing a term here from Morgan, 1997, on the machine metaphor. In the same, Morgan also states (p. 217) that "ways of seeing become ways of not seeing". Procedures, policies or standardised business process demonstrate ways of seeing. "Groupthink, a term coined by social psychologist Janis (1972), occurs when a group makes faulty decisions because group pressures lead to a deterioration of "mental efficiency, reality testing, and moral judgment" (p. 9). Groups affected by groupthink ignore alternatives and tend to take irrational actions that dehumanize other groups. A group is especially vulnerable to groupthink when its members are similar in background, when the group is insulated from outside opinions..."

[124] Gromov, 2014

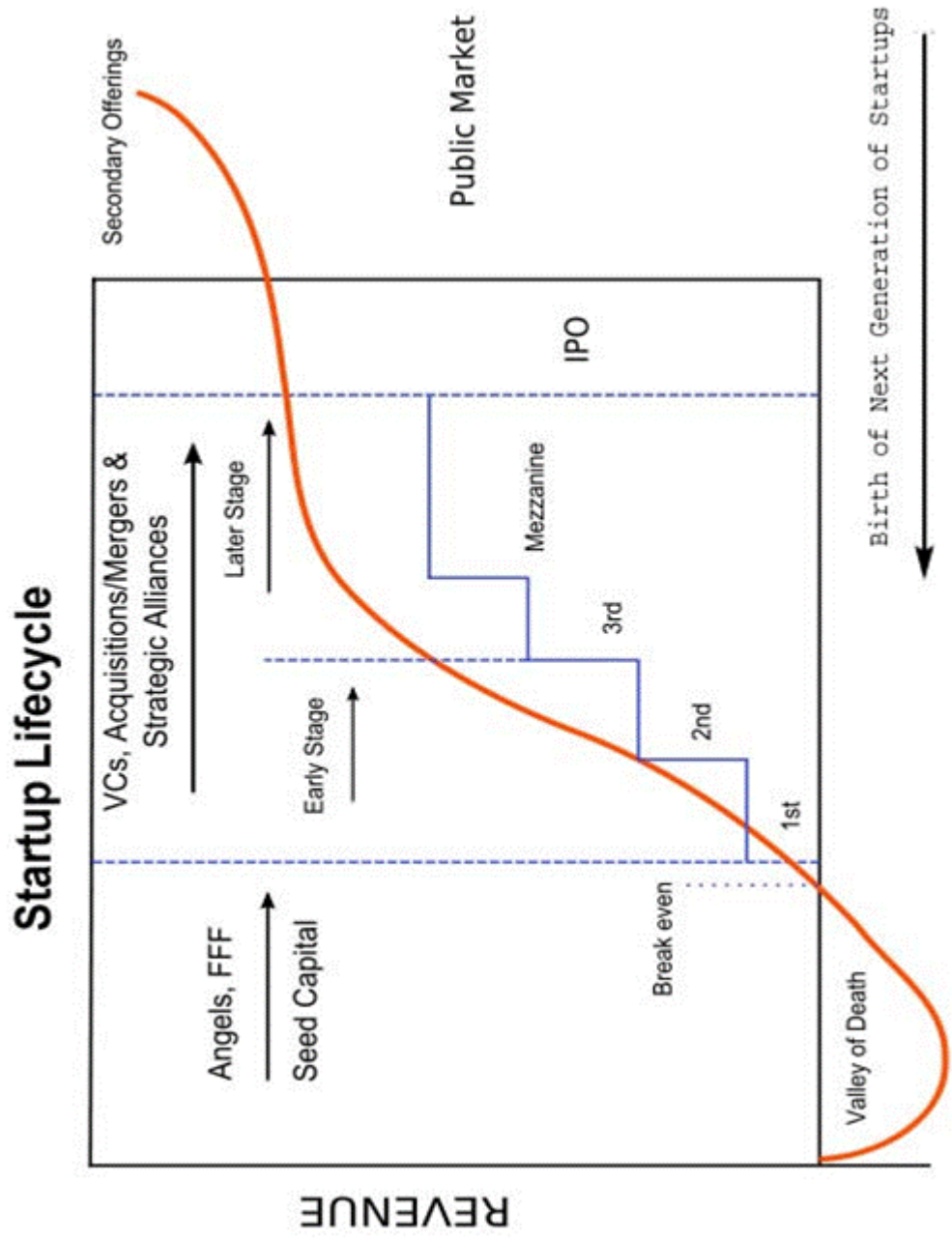

Figure 5. The Start-up Life Cycle[125]

[125] Gromov, 2014

The second point, more specific to this discussion, is the view that the model can be used alongside Rogers et al's to analyse the other component of innovation that Rogers et al do not break down very well in their DIM: the role of money in the development and emergence of novel ideas and how quickly these ideas become commercial or renowned.

The "Start-Up Life Cycle" traces the innovation from the creative stages, called, in this study, the *seed* phase[126]. When compared with the DIM, this may correspond with the innovation's initiator's action towards the early adopters. The *seed* phase can be compared to the stage before the inflection point in the *DIM Model.*[127]

A critical stage is identified as the "Valley of Death". It marks a duration where most concepts *die* or are aborted. This may be from, for instance, their lack of feasibility, lack of conviction of financiers, a realisation of likely lack of return on investment and so on.

> *The cash flow follows a distinct "J-Curve" pattern over time, with an initial drop at the seed stage (The "Valley of Death), related to the financial resources spent on the proof of the business concept. For enterprises requiring significant R&D or product development effort, the "Valley" can be much deeper and longer. If the business emerges from the "Valley" and becomes established, the cash flow turns positive and the business gradually generates market momentum and moves to the early-growth and expansion stages.*[128]

Notably there is recognition of distinct types of funders along the curve in the model from the "seed" stage right through to expansion. It can be argued that the representation does not imply the confinement of a type of funder to a distinct stage. Our interest is the induction of these funders at the stages they get involved. An early observation can be made of the potential comparability between this model and Roger et al's DIM.

Having dealt with the types of innovation and the factors that influence it, the discussion must be extended by explaining the innovation process using the views of Holland, immediately below. Later, Chesbrough and Weick's views on innovation will also be explained to illustrate innovation in action.

Holland, it will be noted, uses mathematical yet also literary approach in his description.

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[126] In Fig. 5. the seed phase is where "Seed Capital" features.

[127] The DIM is reviewed in section 2.7

[128] (ECE/CECI/7) United Nations, 2009

2.4 Holland's Innovation Process

2.4.1 Metaphor

Holland's[129] inclusion in this section is to demonstrate creativity in soft settings. The metaphor may be regarded as a root or seed of innovation. Holland deals with forms of social innovation from an interesting angle, namely social creation spawned by metaphor.

The "source" and "target"[130] concept is metaphorical of innovation. It illustrates instances of innovation. The intention is to present a view from Holland of where innovation comes from. A review of innovation in terms of its types and a description of what enables it was made[131]. In discussing Holland, we attempt to answer the question: Where do innovations come from? How are the ideas developed? And other notions attendant to these questions.

In Holland's description, metaphors have two parts, a "source" and a "target". The third aspect is the association and meaning between the source and the target. The likeness of a model and a metaphor relate to the three aspects. A model is derived from a description, data, and information that shape it.

Holland quotes Morgan also uses the term metaphor. He refers to metaphor in a "broad sense… (to) …include similes and other tropes." [132]

Holland notes the role of perception and how experiences becomes a "glass" that we see through. Experiences are catalysts, he notes. The observer views in the context of experiences.

> *Perception is altered by the metaphoric conjunctions... responses depend partially on individual experiences... (it is further tuned by the context in which it appears, which includes both the surrounding subject matter and the observer's experience...(it) catalyzes, and stands in place of, this complicated interaction.*[133]

Perhaps one of the most insightful of the notions Holland explores is captured in his quotation of Eco[134]who says:

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[129] Holland, 1998

[130] Holland, 1998 p. 206

[131] See Sections 2.2 and 2.3

[132] Holland, I998 p. 207

[133] Holland, 1998 p. 209

[134] Umberto Eco is an Italian "writer, linguist and philosopher"

> *...Metaphor...consists in connecting remote Notions & finding Similitude in things dissimilar, then Metaphor, the most acute and far-fetched among Tropes, is the only one capable of producing Wonder...*[135]

The establishment of likeness or relationships in variant notions, what we may (and indeed as Holland does) label combinations[136], offers good opportunity of creating what Eco calls "Wonder".

When this concept is explored and explained alongside that of models, according to Holland, there the possibility "to see new connections".[137]

The implication from the foregoing, when one considers them in the framework of innovation, appears to be that models and metaphors lie at the centre of creative processes.

2.4.2 Building Blocks

The construction analogy in the use of the phrase "building blocks"[138] by Holland is curious. Firstly, this concept is about combinations and relatedness. The ability to select "building blocks" and having the skill on how they fit alongside each other is what Holland regards as constituting a discipline. It is critical for the blocks to "have undergone testing and selection in the hands of many practitioners"[139]. Also critical is to point that these "blocks" are not of the same kind. They are different yet related. So here Holland is emphasising that creation is not about using the same blocks. He cites the constitution of physics as a discipline and provides that it entails and understanding of not only

> *...motion, mass, and energy, and the forces that transform them (but it also entails learning) tools like the differential calculus...All disciplines have similar requirements (of building blocks)*[140]

The conclusion by Holland to the fact that "[d]isciplines are like metaphors"[141] and we can identify building blocks underlying disciplines. He concedes that "we cannot model the

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[135] Holland, 1998 p. 209. The quotation capitalises the first letters of notion, similitude, metaphor, tropes and wonder. It is as if Wonder et al are people or places. Umberto Eco writes from a novelist, literary and semiotic position. He is interested in meaning and likely to be hyperbolic in instances where stress and emphasis are required.

[136] Holland's thesis revels in the matter of combination.

[137] Holland, 1998 p. 210

[138] Holland, 1998 p. 212

[139] Holland, 1998 p. 212

[140] Holland, 1998 p. 212

[141] Holland, 1992 p. 212. Or "building blocks and associated techniques"

innovation process [and we have] have a long way to go, [because innovation] has a component that must go beyond the stream of consciousness."

It is not a frequent occurrence to discover "new building blocks". It is for this reason, according to Holland, that innovations emanate from the "combination" of old or "well-tried blocks". A similar block may spawn variant forms of innovation as pointed out by Holland when he says that "even when people share the same building blocks, different innovations can arise."[142] Furthermore, building blocks are tested iteratively as constituents of models and "combined to provide novel insights."[143] When there is "familiarity with several nearby disciplines" what is enabled is the "perception of what's nearby". That perception "is a part of that mysterious trait we call insight".[144]

Chesbrough[145], on the other hand, is interested in how organisations must consider themselves as open systems in their approach to innovation.

2.5 Chesbrough's Open Innovation Concept

The notion of open innovation includes co-conception, innovation with customers, markets for ideas, crowd-sourcing, open-source, co-development amongst other types of participation. We can use Chesbrough's conceptualisation of both closed innovation and closed innovation to bring clarity to our focus: open innovation. Chesbrough, below, first explains the opposite concept, "closed innovation"[146] and remarks that it

> *...says successful innovation requires control. Companies must generate their own ideas and then develop them, build them, market them, distribute them, service them, finance them and support them on their own. This paradigm counsels firms to be strongly self-reliant, because one cannot be sure of the quality, availability, and capability of others' ideas* [147]

The apparent characteristics of closed innovation confine it to internal organisational intellectual resources. There appears to be a concern that external input poses a threat of

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[142] Holland, 1998 p. 214

[143] Holland, 1998

[144] Holland, 1998 p. 213

[145] Chesbrough, 2006

[146] Chesbrough, 2006

[147] Chesbrough, 2006 p. xx

compromising the quality of innovation. The organisation is trapped in a fear of what is not outside and relies only on internal resources, expertise and competence. An assumption is made to regard external ideas as unsettling. The proposal is that this becomes the case due to at least three reasons.

Firstly, out of ignorance, those leading the organisation may leave out the input of external stakeholders. This is often the case in very hierarchical and rigid organisations that are managed in a traditional manner.

The other reason organisations chose not to engage external stakeholders is their hope of avoiding time-wasting administrative hassles inherent in sifting too many ideas. It is true that the nature and form of input from outside may get to the organisation requiring to be organised to be meaningful. It is difficult to communicate and find adequate compliance for a standardised form of input from outside. It is easier to achieve input in a required form when an organisation deals with its employees.[148] So, there may exist a fear of the potential inability to make sense of the consequent chaos the input may bring or cause.

Lastly, inherent with openness is an exposure of an organisation's intellectual assets to those outside its system. In the first chapter, we briefly discussed Boisot's treatment of intellectual assets in his theory on the I-Space. Most organisations, as a strategy desire to protect internal intellectual assets from their competitors. This is an understandable concern when good discretion is lacking on what to communicate or reveal.

Innovation processes, with this mindset, are then closed to external participation without any worry of the missing valuable and impartial value-creating customer, market and other views. Chesbrough proceeds to explaining open innovation and says it

> *...can be understood as the antithesis of the traditional vertical integration model where internal research and development activities lead to internally developed products that are then distributed by the firm... Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open Innovation ... assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology* [149]

[148] It is perhaps expecting too much for an organisation to require structured input from a complex system as we should assume stakeholders to be!

[149] Chesbrough, 2006,

Open innovation endorses an open system view. The organisation is a system contributing to innovation. Innovation itself, on the other hand is a system sensitive to internal and external organisational aspects. True value is perceived to come from the interaction of internal organisational innovation processes. Innovation is a dialectical process where ideas bounce and forth between the organisation and environmental entities such as customers, the market, suppliers and other stakeholders. There is confidence that such interaction is worth the threat of losing intellectual information which, in any case, finds its way out encoded in the "product", employees and so on. The more this process is facilitated, the more accelerated the innovation.

Closed innovation suits the mechanical, reductionist paradigm. If products and services must be beneficial and competitive, they must address multiple concerns of diverse groups. Open innovation emphasises heterogeneous actors to achieve this.

Weick's focus is on that heterogeneity and addresses it in what he terms "social creation"[150].

2.6 Weick's Social Creation

Weick[151] tackles the notion of social creativity within his sensemaking theory[152].

Commenting on organisational sensemaking, he quotes Putman who explains that

> *The interpretive approach to organizations is codified as the study of subjective, intersubjective, and socially created meanings that create and recreate social structures through communication*[153]

The perspective here according to Putman is to view organisations in three dimensions: the subjective, intersubjective and the social and how meaning is constituted, and in turn, transform the make-up of the group through just the transmission messages.

Weick picks the subject up in his own formulation and clarifies it.

> *Organizations are adaptive social forms. As intersubjective forms, they create, preserve, and implement the innovations that arise from intimate*

[150] Weick, 1995

[151] Weick, 1995

[152] Weick, 1995

[153] Weick, 1995 p. 68

> *contact...Intersubjectivity is emergent upon the interchange and synthesis of two, or more, communicating selves.*[154]

And the process is not vanity: it is progression towards a superior and more useful status. It is continuous and implied within the sensemaking process itself.

> *When we view organizations as entities that move continuously between intersubjectivity and generic subjectivity, there seems to be a common core that enables us to represent the setting in which organizational sensemaking occurs. Steps toward a composite picture.*[155]

The organisation is a system that contains units acting maybe differently but the set of actions formats a larger sphere. Weick draws on Czarniawska-Joerges insights about this creative process: "Organizations are nets of collective action, undertaken to shape the world and human lives".[156]

The preceding comments are insightful and identify this kind of sensemaking within the province of collective rather than singular action. But Weick must point out that individual ingenuity should find a place even within control and protocol issues. He presents the activity of balancing the two as a tension.

> *The active, ongoing management of transitions is the reason why organizations are often viewed as tension systems... and why the dominant tension is often labelled...as tension between innovation (intersubjective) and control (generic subjectivity).*[157]

So, this sensemaking process is not smooth and incorporates a degree of openness. The consequence is therefore ambiguity rather than certainty. So Weick elaborates the phenomenon very well when he says

> *It is the very openness associated with this perspective that makes distinctions between out there and in here inventions rather than discoveries, that results in people creating their own constraints, and that triggers the strange sequence in which outputs become the occasion to define retrospectively what could have been plausible inputs and throughputs. In short, as we move from that which is rational, through that which is natural, to that which is open, we*

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[154] Weick, 1995 p. 72

[155] Weick, 1995 p. 75

[156] Weick, 1995 p. 74

[157] Weick, 1995

> *concurrently move from structures, processes, and environments that are less ambiguous to those that are more so.*[158]

Stepping away from subjectivity, and past rationality, the consequent focus may be ambiguity. This is because the amount of information that is acquired through the various activities, incidents and processes accumulates to the point of overwhelming our ability to analyse it. There is an increase in information and this gives rise to ambiguity.

The phenomenon of ambiguity, amongst others, is perceived from another dimension in the DIM.

[158] Weick 1995,

2.7 Diffusion of Innovation Model (DIM)

2.7.1 DIM Definition

In several instances before this section, and especially in the discussion about the role of finance in innovation, reference was made to the DIM[159].

The DIM[160] presents an opportunity to view innovation as an emergent phenomenon. Chiefly, it analyses how customers, termed "adopters" by Rogers et al, engage or disengage with a new idea or product. As can be seen, Rogers et al offer an analysis on the diversity of the adopter group. Rogers et al. explain the model as follows and say that

> *.... innovations model (DIM) is concerned with how innovations, defined as ideas or practices that are perceived as new, are spread (Rogers et al, 2003). . Diffusion is the process through which an innovation spreads via communication channels over time among the members of a social system. This is a social sciences definition of diffusion, one that is not to be confused with the thermodynamic definition of diffusion.*[161]

The phrase "over time" has an evolution notion about it. We note also that the subjects here are "members of a social system". There is also a perception of the concepts as "new". The phenomena that calls for focus, are "ideas or practices". This is a wide description and takes in products. Protracted developments are a feature of the DIM. Rogers et al. calls each of these developments a "process" and brings out that the subjects of their process are "members of a social system". We ascribe a special interest to "systems". They seek to divert the discussion from physics by divorcing it from "thermodynamics".

2.7.2 Diffusion

The concept of diffusion in systems, innovation and system flows is dealt with by Boisot[162]. We dealt with Boisot's I-Space in Chapter 1 in some detail. The DIM is about the spread of ideas and practises in systems, albeit social in this case.

The balance of the argument is one that proves that the movement of information can be likened to a process of innovation. Ideas are new information or novel concepts having the potential for adoption and with the potential to improve a situation. In this sense, a discussion

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[159] For instance, in Subsection 2.3.6

[160] Rogers et al, 2004

[161] Rogers et al, 2004

[162] Boisot, 1998

on how ideas are adopted stands to benefit from a theory, like Boisot's on the flow of information.

2. 7.3 Heterogeneity

Heterogeneity is a property that characterises most social systems. It grades variety within a system. In DIM, Rogers et al. acknowledge the heterogeneous nature in some of the areas and it is important to note the significance of this property to social systems.

> *Agent heterogeneity refers to the degree of heterogeneity that agents, the basic units of complexity, are assumed to have. Traditionally sciences have assumed agents to be homogeneous – all atoms or molecules alike, for example (Suppe, 1977; Casti, 1997). In contrast, the social sciences have progressively emphasised the uniqueness of agents for purposes of analysis within a discipline (e.g., sociologists do not assume all social entities are homogeneous), instead focusing on the elemental properties of agents as increasingly heterogeneous, more clearly defined, and more distant from the properties of adjoining agent.*[163].

Traditional sciences' notions obey mechanistic principles and reductionism. Agents must be perceived as individuals, even if they share a common background or identity, as in students of customers. They present a mixture of traits, preferences, personalities and so on.

2.7.4 Diffusion scales

In regarding broader and narrower behaviour, Rogers et al. refer to these as scales:

> *Diffusion theory... looks at both the fine and global scales of behavior and the relationships between them, and it illustrates emergent behavior and feedback when aggregates of individual behavior scale up to a similar behavior on a system level. Beginning with the level of local interactions, the fine scale, diffusion takes place through a network consisting of individual units (potential adopters). The adopter unit can be an individual or an organization ("individuals" hereafter, for simplicity).*[164]

The noun of choice here "scale", contextually refers to zones and dimensions if not areas of focus. More so when these "scales" are said to have "relationships". That they have "local interactions", the fine scale is an interesting phenomenon in a systems sense. "Organisation", in this social sense, and the context of this discussion, is also conjured.

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[163] Lichtenstein and McKelvey, 2011

[164] Rogers et al, 2004

The fine scale apparently does not relate to individuals only. Rogers et al. relatively speak of scales. When a group's behaviour is subjective to institutional or organisational behaviour, the smaller unit's behaviour is regarded as the fine scale. The theory does not treat the fine scale lightly. Individuals account, as an aggregate, for global scale behaviour

> *Diffusion theory is similarly dependent on networks in which individuals interact locally with their neighbours...*
> *Individual adopters are not usually cognizant of their contribution to a higher-scale order; rather, they make their decisions about innovations on the basis of their own perceived circumstances...network adoption of innovations is maintained despite population turnover, often for generations, even as different system levels influence one another.*

In addition to the influence of individuals on each other in a contemporary setting, there is also a trans-generational effect. Social systems inherit versions of old innovations and carry them over. They borrow from old innovations.

> *The macro-scale: the innovation diffuses. Micro-scale behaviours—frequent instances of adoption—create macro-scale phenomena, such as the establishment of a consumer product standard (set up to say later this is like an emergent property/phenomenon). The often-cited triumph of VHS over Beta is a case in point.*[165]

The perspective preferred in DIM is bifurcated outlook of scales. At the micro scale, there is assimilation of behaviour between individuals. The macro scale illustrates the wholesome picture and shows behaviour of the social system. It illustrates the success of the diffused behaviour as a widely-accepted trend.

> *Diffusion theory...looks at both the fine and global scales of behavior and the relationships between them...*[166]

There are two distinct scales, the fine or local and global scales. It is insinuated here that, in DIM, there are relationships between them. There are diverse types of adopters and they comprise sub-units within the group. The group is therefore a unit manifesting global behaviour. Members within the group have individual influences on the adoption of innovation. This is because it diffuses through them. They are micro-players.

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[165] Rogers et al, 2004

[166] Rogers et al, 2004

> *Each individual can be self-located in one of the five adopter categories (innovators, early adopters, early majority, late majority, and laggards) and the network provides connections through which an innovation spreads...*[167]

There is clear scaling in processes within the group of potential adopters. A key process incited by early adopters is perturbation[168]. This creates a churning of ideas within the group itself as if it is an incubator of ideas. The unit itself has interesting characteristics. Amongst these, "above-average network-connectivity", "reactivity" and heterogeneity[169]

Another key process, an interesting irony pointed out by Rogers et al, is a formation of innovation occurring within early adopters and during diffusion. It is an innovation of the innovation[170].

We can state a further characteristic of the adopters group: *homophily*. Its influence and function in this group is explained by Rogers et al. this way,

> *Homophily is the tendency to selectively interact with and learn from culturally-similar others, so that degree of homophily refers to the extent of prior affinity among network actors, including proneness to accept innovation. Greater homophily allows for greater ease of diffusion (although as previously stated, a degree of heterophily regarding an innovation is required for reactivity), while high degrees of heterophily raise barriers to diffusion. At extreme values, high heterophily makes diffusion almost impossible, as several studies illustrate...*[171]

Heterophily must be found to be in primary level phenomena, physics for instance. It permeates most science fields. We should consider *heterophily* as *culturally-dissimilar others* in the sense that it is opposed to *homophily*.

2.7.5 Uncertainty in DIM

> *...uncertainty is the degree to which a number of alternatives are associated with the occurrence of an event but the relative probability of the alternatives is unknown...Uncertainty is a barrier to diffusion, and its antidote is information. A certain degree of uncertainty always characterizes an*

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[167] Rogers et al, 2004

[168] Understood in this study to mean: disturbance or unsettling activity within a system.

[169] Rogers et al, 2004

[170] Verb in the former and noun in the latter "innovation".

[171] Rogers et al, 1998

> *individual's perceptions of a new idea, practice, or technology, which is one reason why the diffusion process occurs gradually*[172].

There is a desire to work with predictable phenomena. When we are certain about consequences, we plan and commit resources with accuracy. So, the risk of loss is low and speculation minimal. Although certainty is desirable, in ideal and common social systems, it is impossible to guarantee. Uncertainty is the major reason why we should discuss early and late adopters. Early adopters, as discussed elsewhere in this chapter, can absorb the risk. Late adopters, on the other hand, are concerned about placing early trust in an innovation. There was a discussion on uncertainty in Chapter 1 when we focused on Weick[173].

2.7.6 Diffusion of Innovations Model – An Illustration

We discuss, below, a graphic illustration of DIM. Whether all innovations diffuse in this manner will is debatable. The model is a sensible representation of the adoption of innovation. The *x*-axis represents the rate of adoption. The *y* axis represents the increase or decrease in the number of adopters. There are interesting lessons from the graph. Firstly, the trend does not follow a straight line incremental style. It has five key points. Close to the "0" point (or where the axes meet), there is a very low rate of adoption. We may formulate the dominance of traditional systems[174]. Rogers et al. make the following points about the second point,

> *A continuing increase in the number of adopters, or synapses, or processing elements, increases the energy being processed in the local system at the inflection*[175] *point. Until that point of critical mass is reached on the S-curve, the rate of increase in the number of adopters per time unit is nearly linear. Complexity begins at a threshold of nonlinearity (So, Chen and Chen, 2005). In the diffusion system's rate of adoption, this critical threshold has also been called the tipping point...*[176]

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[172] Rogers et al, 1998

[173] Weick, 1995

[174] Methods, mechanisms, ways and so on

[175] Reading Rogers et al. text, the preferred meaning of this term seems to be that referring to the notable change in a curve or direction

[176] Rogers et al, 2004. According to Gladwell, 2000, concepts on the "tipping point", a tipping point is that stage when adoption of a phenomenon gets rapid. A contemporary term now used for this is "going viral".

Non-linearity introduces complexity within diffusion. Up until the inflection point, the interaction amongst adopters is such that critical mass[177] has not been achieved. Our questions seeking to understand the causes of the shift, in other words, the reason for trends or when it happens, in other words, what causes the shift to happen at the time that it does, require complex explanations. It is not easy to predict when the inflection happens. It seems that this is determined or influenced by several factors. Some likely reasons for are briefly explained below.

The relationship between early adopters and the rest of the adopter population may affect the shape of the inflection on the graph, that is how early is peaks, how long it rides at the peak or fast it drops from the peak. The degree and kind of engagement, that is, the intimacy between the two groups is a factor that may affect adoption by members of the population who will adopt after the early adopters. Rogers et al seem to be pointing out this information when the use the term "system reactivity".[178]

The strategy of the initiator/s is another factor that may determine inflection. In the discussion on brand innovation, a point was made on the sensitivity to the customer. There must be an awareness by the initiator of the innovation, and in some cases, the early adopters, of the appropriate media and strategy to enable a quicker spread of the idea or innovation. The objective is to quickly realise the benefits of innovation relative to the degree of fatigue on finances invested on the innovation. Of course, this should be accompanied by sufficient information and dissemination of product information[179] to ensure sustainable adoption.

Lastly, and not requiring too much emphasis, the appeal of the idea is a significant determinant of the inflection graph. Alternatively, this refers to the appeal of the idea where options exist. Novel ideas must be offered for adoption after thorough studies on their usefulness and assessment of competition. The term "competition" is relative. In discussing innovation, the concern is on novel ideas. There is likely to be a tendency, however, for adopter populations to regard what is new as being like something they already know or use. But even radically innovative ideas are also subject to a worse fate: it may be hard to prove their benefit if civilisation has existed so long without them!

The adopter unit is a system and there is interaction within the adopter unit (by their location/nature). Diffusion therefore represents the maturation of an idea. In other words, the

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[177] That is, the ideal number of adopters to cause significant adoption by later adopters.

[178] Rogers et al, 2004

[179] As opposed to hype that creates a "bubble".

actualisation of an initiator's idea, his or her objective, is mass adoption of the idea. It is a fact that an idea's adoption cannot start popular. It is made popular by targeting amenable or ready parts of the adopter unit. Whilst mass adoption is desired, some ideas die before they are significantly adopted[180].Early adopters populate a zone at the first inflection point before the peak. The zone at the peak point is populated by a very heterogenous group.

Our next focus is the "negative" deflective point. In the zone, interest to adopt in the zone is once again low. There is need to be curious about the causes of this *death* of diffusion at this point. It is certain that this is caused by a scaling of ideas, either a viable substitute or a merged one[181]. Ideas give way to better ones. Existing at the peak of an idea, where there is mass adoption, it is not easy to fathom what the next "big thing" is. It is not an irony that it would be easy to trace innovation backwards and very difficult to project its diffusion rate or even adoption.

[180] This phenomenon was dealt with in some detail in the discussion about Start-Up Life Cycle, Figure. 6.

[181] Defined as a merged substitute

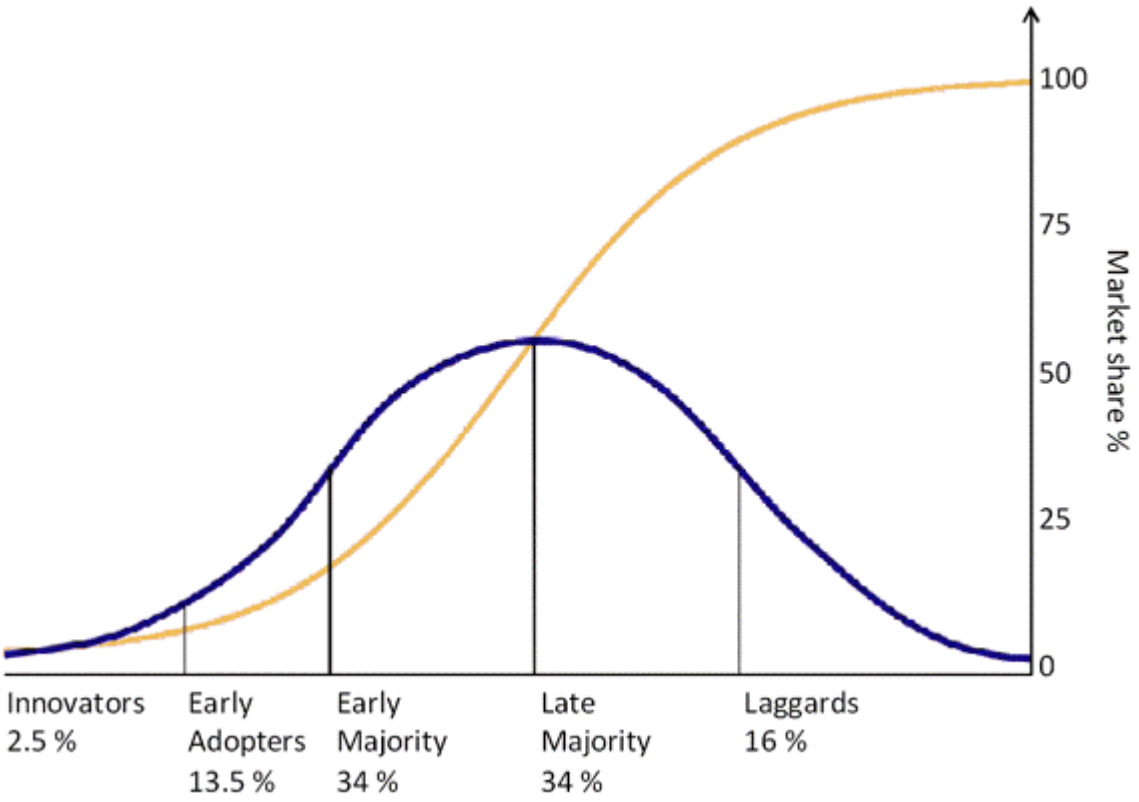

Figure 6. An illustration of the DIM – Adoption Rate[182]

Rogers et al. regard the target of innovation as adopter units.

> *The adopter unit can be an individual or an organization ("individuals" hereafter, for simplicity). Each individual can be self-located in one of the five adopter categories (innovators, early adopters, early majority, late majority, and laggards) and the network provides connections through which an innovation spread...*[183]

Adopter units are like macro-scales. They are zones of interaction and may be composed of like-minded professionals. They are like communities of practice[184]. Within their ranks, it is

[182] The illustration is adopted from Mascola Insights, 2004. For this study, only the blue line in the graph is referred to.

[183] Rogers et al, 2004

[184] Communities of practice or CoPs are formally or informally organised groups of individuals sharing the same field or pursuit who interact regularly to know more about their common pursuit or how to improve on it (Wenger, 2009). The notion was first described by Lave and Wenger in 1991 (Eckert, 2006).

possible to scale down, to the "micro-scale"[185] and develop an interest in how they are organised into cliques and sub-groups.

> *As individuals adopt an innovation, their microbehavior contributes to the macrosystem-level scale of behavior.*[186]

2.7.7 Variety

Variety is a strong theme in the DIM. It refers to the existence of entities with different attributes in a system. In the case of the DIM, variety addresses the population of the adopter unit by individuals with distinct levels of acceptance or readiness to innovation.

> *Variety is found in diffusion theory as heterophily, or degree to which individual communicators differ along traits pertinent to predisposition toward adoption.*

There is an irony about variety. It presents both an opportunity and a challenge. This depends on how high or low it is.

> *A very high degree of heterophily will likely slow down diffusion, but some degree of heterophily among communicators is nonetheless necessary for an innovation to spread (that is, a source individual must know more, and is assumed to know more. about the innovation than a receiver one)*[187]

Variety should be regarded as a hallmark of complexity[188] within the adopter unit and there are several ways of viewing this complexity.

Firstly, all potential adopters bring in a significant amount of beliefs that help format the enhancement of the innovation. This is general referred to as critical review. Even two people with an optimistic or pessimistic assessment differ in what they perceive. Backgrounds determine how phenomena is judged.

Secondly, where potential adopters are scarce, innovation is not open to mass adoption. It is a positive phenomenon that innovation is at the disposal of a heterogenous group.

Further, filtration always occurs in the innovation process. This can be akin to testing and similar concepts. Resembling an uncontrolled experiment, innovations develop in a "social laboratory" which is really the spectrum of adopters.

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[185] Rogers et al, 2004

[186] Rogers et al, 2004

[187] Rogers et al, 2004

[188] Indeed, in the Cynefin Model, which will be reviewed in Chapter 3, and in other literature, the ideal zone to locate manageable creativity is between complexity and order. That zone, the "edge of chaos", fits the description merging "homophily" and "heterophily".

2.7.8 Early Adopters' Characteristics

Rogers et al. have an interesting perspective on early adopters.

> *...innovations diffuse more rapidly and successfully in highly reactant social networks, through relatively heterogeneous early adopters, who have the highest level of adaptability to change. They typically have high levels of disposable resources (high socioeconomic status), relatively more exposure to adopters from other social networks, and the inclination to try new ideas...*[189].

They have an open-mind and tend to have good horizontal knowledge. Not quite inventors, they have a risk appetite that is greater than other potential adopters. Early adopters' quality of having high levels of disposable resources is a special characteristic. Their possession of resources may be interpreted as their ability to suffer loss and rebound[190]. Leaders of organisation like Tesla and Google apparently exhibit this quality. It may be preferable to regard this alongside enablers dealt with in this chapter[191].

We can further analyse the anatomy of the group of potential adopters still referring to Rogers et al.

> *An innovation comes into a system from outside, usually via an innovator or early adopter. Early adopters ("cosmopolites") are typically sufficiently respected in their local communities (relative to innovators and outsiders) that others are willing to follow their lead. They, then, function as role models. An early adopter may also be an opinion leader, and/or well connected, so that s/he has above-average network-connectivity in the system (Rogers, 2003). Early adopters are therefore highly reactive—heterogeneous—and their behavior is conducive to reactivity in others, as they increase perturbation around themselves by virtue of their propensity to innovate. Once brought into the system, innovations diffuse through networks of social ties.*[192]

The application of the term *cosmopolites*[193] to early adopters is revealing of their nature. Rogers et al. seem to imply their flexibility or versatility. Early adopters are open-minded people who are also keen adopters. This *cosmopolitan* characteristic of early adopters means

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[189] Rogers et al, 2004

[190] The ability to suffer loss may be due to "last ditch" situation or for survival and not based on an abundance of resources only.

[191] In Section 2.3.

[192] Rogers et al, 2004

[193] Understood to mean individuals with the ability to function in a cross section of cultures.

they function within the edge of chaos[194]. This zone at the periphery of a system is highly active and it is like a border. It is an area of interface and a playground of early adopters. It is easy here to export properties of systems in the vicinity and market them to potential adopters. So, we could, in a way, regard early adopters as promiscuous and risk-takers. Early adopters are good importers.[195]

There are generally two broad types of adopters: early adopters, whom we have located at the edge who are less risk averse, and there are late adopters. The low appetite by late adopters to quickly adopt ideas stems from their uncertainty about it. One of the strengths of early adopters, the cause of their desire to quickly adopt is that they have significant resources available to them. They are not worried about the *valley of death*[196] or failure. One form of resource Rogers et al. point out is information. It is associated, as a remedy, with uncertainty,

> *Uncertainty is a barrier to diffusion, and its antidote is information.*

Rogers et al. describe uncertainty as

> *...the degree to which a number of alternatives are associated with the occurrence of an event but the relative probability of the alternatives is unknown*

In contrast, so we can conclude, it is possible that late adopters lack information by which to decide. Information, as pointed out, is not the only resource that may be wanting. Adopters may lack financial resources, they may live in an environment that is restrictive and may simply be too inundated.

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[194] The edge of chaos is a virtual zone in systems conceptualized by Farmer (Keirsey, 2015) and popularized by Packard and Langton, a mathematician, where complexity is rife because it straddles order and chaos. It is generally regarded as presenting an immense potential for creativity. In Chapter 1, Snowden's Cynefin model that exploits this notion.

[195] In fact, this is how neologisms are conjured and new language forms emanate. Languages are formed and transitioned this way. Indeed, language formation and transitions are forms of innovation

[196] See a later discussion

2.8 Conclusion

Innovation was presented as an open concept embracing the input of both internal and external sources. Chesbrough and Dey's ideas about both types of innovation as well as the enablers of it were presented. The discussion on enablers included that of objectives and strategy which emphasised the function of leadership in innovation. When we consider a culture of challenge, we are putting forth the idea that innovation is led. In addition, how strategy is framed determines the organisational resources that are provided for innovation and how much focus there is on this organisational facet. Culture therefore has boundary effects on creative behaviour and may curtail or promote innovation. The notion of open innovation by Chesbrough highlights that innovation is a systemic thing,[197] where the organisation is a system contributing to innovation and in turn innovation is a system by itself sensitive to aspects inside and outside the organisation.

The "Start-Up Life Cycle"[198] presented an opportunity to analyse, in graphic form, the role of funding in innovation. We remarked on the relationship between this model and the DIM. The model emphasises value from the perception consumers or late adopters and highlights that funding is a critical aspect in innovation. We remarked earlier on the link between strategy and funding.

Holland's theory illustrates that in the scheme of innovation, models and metaphors are key to the creative processes. Drawing from what is known or old, using these as blocks, innovations and novelty is become possible. The process, it can be concluded from the discussion on Holland, is not linear.

Weick's social creation explains why there is a rise in ambiguity and uncertainty. Uncertainty must not be interpreted as vanity. It still illustrates the complexity about social creation. At every state, the social system presents forms that are an improvement from preceding states. It depicts social inventions as the results of both individual and collective input even within the existent of tension.

The DIM was useful in analysing processes that occur during the adoption of innovations. We took interest in the fundamentals around early adopters who are characteristically *cosmopolitan* amongst other interesting characteristics; heterogeneity, which is a property that characterises most social systems and the uncertain late adopters. Like Dey and

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[197] Systems view is the perception that an entity functions as a relationship of several systems with it. A systems view helps in emphasizing complexity.

[198] (ECE/CECI/7) United Nations, 2009

Chesbrough's concepts, the DIM serves to illustrate complexity in innovation. It especially focuses on the perpetuation of innovation rather than creativity. The low appetite by late adopters to quickly adopt ideas stems from their uncertainty.

The critical lessons from this chapter have been that:

1. Innovation is about improvement of an entity's delivery of business to its customers. The improvement that innovation delivers to customers equates to value for the business.
2. Innovation is complex in that it is determined by a multitude of factors named enablers. These have an influence on its success. Enablers range from culture to business processes and finance. The influence of finance to innovation was explained using the "Start-Up Life Cycle"[199].
3. Social factors have a role in innovation and innovation must ideally be exposed to the influence of a business' stakeholders. Weick and Chesbrough's insights, alongside those of Holland, emphasises the "soft" dimension of innovation. Innovation should not take place isolated from social influences.
4. As an extension of the observation about social factors in innovation, it is worthwhile to consider the reception and assimilation of customers, identified as "adopters" by Rogers et al, in the innovation process. They can cause success or failure of innovation regardless of whether it is well financed or has the potential to improve their lives or add value. There must be a healthy variety of those who are willing to quickly adopt novel ideas and those who are slow at adopting them. The insights from Weick, Chesbrough, Holland and Rogers et al recognise heterogeneity in innovation.

[199] (ECE/CECI/7) United Nations, 2009

Chapter 3
Emergence as a Concept – Emmeche et al

3.1 Introduction

This chapter will describe and analyse a classic paper on emergence by Emmeche et al.[200] The three authors, Emmeche, Køppe and Stjernfelt come from diverse fields. Emmeche describes himself as a theoretical biologist and has a special interest in artificial life which involves simulations and complexity notions.

The two other authors who collaborated also have fascinating profiles. In the section explaining their choice of comparative analysis, the authors comment about their article and say

> *(The) combination of historical discussion, conceptual analysis and argumentation compatible with science is our explicit - and pluralistic - choice in this article. It not only synthesizes the three authors' different backgrounds (philosophy, biology, linguistics, literary criticism, psychology), it also proves to be a fruitful way of dealing with a concept of this kind.*[201]

The terms *pluralistic* and *synthesis* have a great bearing in the formation of this thesis[202]. On occasions synonyms of these terms, "multiple", "interdisciplinary" and "combination", are explored as critical notions in both emergence and innovation. These latter three terms bring out almost the same notions as do "pluralistic" and "synthesizes". Køppe is a Danish psychologist and philosopher of science. He is a professor of psychology at the University of Copenhagen. Stjernfelt is a Professor of Philosophy of Science, History of Ideas and Semiotics at the Department of Arts and Cultural Studies. This inter-disciplinary and pluralistic nature of their project is a theme running in this thesis.

This chapter has the role of explaining emergence from the perspective of Emmeche et al. It will describe how they explain emergence by way of an ontology of levels.

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[200] Emmeche et al, 1997,

[201] Emmeche et al, 1997

[202] That is on exploring emergence in innovation and using emergence as an explanation of emergence.

> *...sciences clearly indicate(s) that a philosophical concept of emergence as something exceptional and in principle unexplainable by science always runs the risk of being overridden by history in the development of science.*[203]

In other words, we must push for a scientific explanation of emergence. If we maintain emergence as a lofty idea that is beyond explanation, we may end up with it being considered as a worthless idea that has no use or function in current philosophical thought. In that sense, it may only be remembered later as a concept that had little consequence in academic matters. This then leads to a conclusion that Emmeche et al. are working, in their thesis, to say emergence is explainable and has function in contemporary subjects. Their thesis finds a solid foundation in Lloyd Morgan's treatment of emergence[204] and but incorporate a dimension of levels to it. A strong emphasis is placed on emergence's roots in vitalism[205] having "vitalistic" roots and how it was devitalised[206]

> *...any non-reductionist theorist of levels must imply some version of the concept of emergence*

Emergence is initially distinguished by two characteristics. The first, is that it is "non-reductionist". It assumes a concept that is on a spectrum in variation to reductionist notions. The ensuing analysis identifies it with complexity. The second characteristic, enables theoretical descriptions that identify levels to qualify as explaining versions of emergence. The question may be to ask whether emergence is a model, notion[207], theory or framework? Emmeche et al. have regarded it as each of these in various sections of their study. First, they regard it as a notion that "if there is not any principal difference between the "jump" (as the popular notion of emergence is often named)."[208] and in several other instances as a concept, for instance: "In a broader historical view it is a fact, that the concept of emergence does have a central position inside these new domains."[209]

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[203] Emmeche et al, 1997

[204] Morgan, 1921. Morgan regards "emergence" as "emergent evolution".

[205] A philosophical foundation, the basis of some theories that supported the belief that life emanates from an unexplainable vital or supernatural force.

[206] Deprived of an immaterial causal agent or teleology OR became creation of new properties regardless of the substance involved

[207] This term's connotation is not very divorced from "concept". It is also synonymous with "idea"

[208] Emmeche et al, 1997

[209] Emmeche et al, 1997

Of interest to this study, is a submission by Emmeche et al. below that says,

> *If ontologically interpreted then, emergence will characterize the one and only 'creative force' in the whole universe, and if epistemologically interpreted, it will be a name designating a large scope of various and perhaps very different types of processes.*

Considering the objective of this study, it is necessary to understand their thesis and establish the above claim's validity on innovation processes. It is a good starting point to understand their definition of emergence.

3.2 What is emergence?

In their article, there are instances where Emmeche et al. define emergence. Generally, for them it is "the denomination of something new which could not be predicted from elements constituting the preceding condition."[210] In this definition, the key phrases are "denomination of something new" and "could not be predicted". Both concepts of "new" and predictability have sections devoted to the later. In the philosophy of "new" we should, each time, wonder about whether what is manifest was expected and variant to expectation. This notion appeals to our desire for control and to preparedness. As they put it, "emergence is exactly that reasonable aspect of vitalism which is worth to maintain."[211]

In this claim, the authors use the "compare and contrast" tool to illustrate what emergence is by stating that it is deducible from vitalism. The balance of the vitalism theory is not valid in contemporary theory. In other words, emergence is described as having emanated from vitalism. To understand emergence, we should trace its vitalism roots. The authors then narrate tenets of vitalism to validate their claim that "emergence is first of all defined as "the creation of new properties."[212] Their article relies heavily on a definition by Morgan of emergence as "creation of new properties". The definition phrase "creation of new properties" is explored and broken down in terms of three key words: "creation", "new" and "properties". In the thesis, it is explained that the critical omission in Morgan's explanation of emergence is the notion of supervenience and levels.

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[210] Emmeche et al, 1997

[211] Emmeche et al, 1997

[212] Emmeche et al, 1997

> *Emergence is among other things the concept which relates levels to each other - or to be more precise, the concept which denotes the very passage between them.*[213]

In keeping with the assertion by Emmeche et al. that Morgan's explanation omits a key notion in emergence, supervenience, the authors add a definition using that missing dimension. Emergence must also be described as a notion that acknowledges the function of levels in complex phenomena. The key phrases in this description of emergence would therefore be "relates levels to each other" and "passage between them". This implies both relatedness and dynamism.

> *...emergence is at stake at the borders between the large sciences: where the explanatory power of one science must give in, another must take over at the level of the hitherto unexplainable - emergent - property. But it is not possible to restrict emergence to these borders.*[214]

This description of emergence is rooted in the philosophy of explanation. Subtly also, and clear in the thesis, it also implies the existence of levels and relationships. In a sense, therefore, it is an emphasis of the description we dealt with immediately above since it recognises the existence of more than one dimension and progression – what we called dynamism – in the phrase "must take over".

In saying "emergence is used as the description of the creation of primary levels, creation of sublevels, and creation of single entities"[215] Emmeche et al highlight and emphasise, by the force of their repetition, the idea that emergence is concerned with creation. In all three cases, "creation" is a common process. This definition appeals therefore to our understanding of levels in emergence more than it does to how these levels are related.

The ""jump" (as the popular notion of emergence is often named)"[216] used by Emmeche et al to signify the differentiation from level to level is a deceiving term. As explained in a discussion on supervenience later, the differentiation from level to level is a relationship and coexistence. "(J)ump" cannot be taken at its value and made to imply a sudden movement or quick transition. More precise, is their description that "emergence is not an omnipresent creative force, but simply the fact that some of these virtual processes possess new

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[213] Emmeche et al, 1997

[214] Emmeche et al, 1997

[215] Emmeche et al, 1997

[216] Emmeche et al, 1997

properties."[217] It offers emergence as being outside mysticism but still describing "processes" within the spectrum of the "virtual".

The above description here is delineating. The attempt here seems to be to present, in true detachment from supernatural and immaterial vitalistic notions, emergence as being within the grasp of scientific explanation.

In the statement "(t)his latter process of a level constituting emergence is in general the process unfolding when the potentialities in the entity develop in relation to other entities"[218] There is an acknowledgment, in this description, of emergence's complexity nature. Also, not to be ignored is the notion of "potentialit(y)". This implies indeterminability and the difficulty of knowing outcomes related to the entity. Therefore Emmeche et al. must point out that "emergence is not necessarily unexplainable,"[219] and that "emergence is not an indeterministic process."[220] The concept of emergence "is opposed to those of reductionism, determinism and/or mechanistic materialism."[221] A point is made here to separate emergence from mechanistic materialism and reductionism.

There is an interesting dimension to this discovery of so many descriptions of emergence by Emmeche et al. They state that it is their preference to offer this multiplicity of views about this subject. It is ideal to offer different versions of description when dealing with a "difficult" topic as it is. We should also allow the view that "emergence is used as the description of the creation of primary levels, creation of sublevels, and creation of single entities."[222]

Emergence is also an idea and a process.

> *The idea of emergence may refer to two kinds of processes: first, processes that we cannot explain at present, but which are not in principle unexplainable, and second, processes that in some use of the word are in principle unexplainable.*[223]

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[217] Emmeche et al, 1997

[218] Emmeche et al, 1997

[219] Emmeche et al, 1997

[220] Emmeche et al, 1997

[221] Emmeche et al, 1997

[222] Emmeche et al, 1997

[223] Emmeche et al, 1997

There are two forms of processes it has been applied to in the above conceptualisation by Emmeche et al. The first can be understood to be phenomena that cannot be clarified using our current knowledge. Their determinants can be identified but it is difficult to reasonably spell out the interactions that finally give rise to a phenomenon which presents. The second form, lies outside our ability even to define the determinants. Emmeche et al. therefore confidently conclude that "emergence is a genuine phenomenon"[224]. The announcement here is almost like a conclusion[225]. The employment of the word *genuine* is curious. We make a point that the thesis appears to contain a series of rebuttals. It is work designed to strengthen the emergence argument. In other words, the claim is that emergence is an authentic scientific notion worthy of study, focus and application for contemporary phenomena.

3.3 Creativity

Creation was a strong theme in the explanation of emergence in Section 3.2. A focus on "creation" and the noun "creativity" seems to be one of the key exercises in understanding Emmeche et al's perspective on emergence.

By saying that "if we restrict creation to its possible scientific meaning - and not its religious - there will always exist some conditions for the creation of a new property"[226], Emmeche et al. seem to be making a commitment of emergence to the scientific and not the supernatural. They also add that new properties are being created "regardless of the substance involved".[227] But what is "substance"? We may consider substance not only in the tangible sense but in the conceptual sense as well – philosophical substance. The limits of semantics are obvious here and we can be satisfied by this inference if we can follow Emmeche et al. depiction that "it is beyond the wit of man to number the instances of emergence"[228], and that, "there will always exist some conditions for the creation of new properties"[229]. So, if emergence is the creation of new properties, and opportunities for emergence are countless, with new properties are being created regardless of the substance involved, and emergence will characterize the one

[224] Emmeche et al, 1997

[225] This statement is made after several deductions and is done near the end of the thesis.

[226] Emmeche et al, 1997

[227] Emmeche et al, 1997

[228] Emmeche et al, 1997

[229] Emmeche et al, 1997

and only "creative force" in the whole universe, we may conclude a wide, material and immaterial application of the term "substance".

Firstly, "create" is a verb. The strict application of the term in emergence however restricts connotations of getting ingredients or resources together and "making" as in baking or building a house. Such a conceptualisation would be reductionist and mechanical and of little interest in complexity studies. The etymology of the word "create" provides some insight into the application of "creation" by Emmeche et al. The etymology of the word is connected to the Latin word "creāre". We must separate the one connotation of the word linked to divine creation which is almost like saying "to make out of nothing[230]. The closer connotation is "to grow".[231]A Greek equivalent of it is "κόρη" referring to a child and meaning "the ones that are growing = kids."[232] From an etymological background, therefore "create" refers to phenomena that have some self-organisation and complexity as of a biological or astrological nature.

The inclination in Emmeche et al's use of the term "creation"[233], and they explicitly exclude the religious connotation, is associated with the following terms that they employ

1. constituted: as in, for instance, "when the level is constituted"[234]. Constitution implies the coming together of many constituents or entities. There is a notion, in the term "constitution" of the formation of a whole from many entities.
2. explanation: as in, for instance "historical explanation…structural explanation"[235].
3. inclusive: as in, for instance, "Levels are inclusive…"[236]
4. supervenience: we deal with "supervenience" [237] in section 3.7.
5. regularity: as in "regularity should rather be interpreted as the "formal cause""[238]

[230] Jacquet, 2013

[231] Jacquet, 2013

[232] Jacquet, 2013

[233] Emmeche et al, 1997

[234] Emmeche et al, 1997

[235] Emmeche et al, 1997

[236] Emmeche et al, 1997

[237] Emmeche et al, 1997

[238] Emmeche et al, 1997

3.4 Determinism and Predictability

A deeper understanding of the notion of creation as a term in emergence should require a contrasting of two commonly confused ideas: that of determinism and predictability. It is critical in this thesis to explore determinism and predictability in depth as well as the complexity insight that determinism does not imply predictability. It is not a conflict. To determine is not to predict. Determinism involves working out the factors that led or lead to a state or states. It does not mean the ability to know, beforehand, the true nature or quality of the state or states. The latter is the claim in prediction and a notion common in reductionist reasoning or in mechanistic phenomena.

Elsewhere Baas and Emmeche article, whilst describing emergence as a notion say that in "the study of complex systems, one often sees that a collection of interacting systems shows collective behaviour"[239]. We may say that emergence has some parallels with holism. An emergent entity has holistic behaviour. That collective behaviour has diametrical implications on prediction and determinism for the entity:

> *...the concept of emergence - formulated as the idea that there are properties at a certain level of organization which cannot be predicted from the properties found at lower levels. We argue that even if determinism prevails, this does not entail predictability.*[240]

This is because we do not know all parameters and factors at play in creation, the same (determinants) act differently at separate times. Determinism is therefore a situational phenomenon. Determinism means we can identify layers but cannot accurately guess the consequence of their interaction. We are always sure that emergence will play out.

> *Emergent phenomena are unpredictable and unexplainable, it seems. They are unpredictable until the moment when they are described....*[241]

Also,

> *Today it is evident that a lot of systems exist which on the one hand are described adequately as being strictly deterministic but on the other hand remain unpredictable.*[242]

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[239] Baas and Emmeche, 1997

[240] Emmeche et al, 1997

[241] Emmeche et al, 1997

[242] Emmeche et al, 1997

The foregoing, to a reductionist, would seem like an irony. Emergence also has application in hard sciences.

Emmeche et al quip, "A lot of processes in physics - and hence also in the many levels and sublevels above physics - are in this way unpredictable even if they still are deterministic"[243]. From this perspective, a mechanical determinism claim that we can determine the outcomes as in making predictions of how phenomena can play out each time is disputable. Emmeche et al. provide a perfect illustration when they give the description below.

> *In principle, given certain boundary conditions, the behaviour and macrophysical properties (such as heat, pressure, volume and temperature) of a gas is only determined by the place and momentum (and form) of every single molecule within it - parameters which we could in principle know - and is thus governed by mechanical laws which are at our disposal. Nevertheless, this knowledge is for practical reasons impossible to obtain, and one has to resort to consider the statistical behaviour of the constituent particles in order to derive the equations of state (of these properties) of the gas, i.e., the phenomena at the macro level.*[244]

Statistical information on phenomena has its uses but it fails at producing enough deductive information us to predict accurately. Small variations on constituent parts can have significant consequences on states or creation. This characteristic is typical of complex phenomena.

Further, our operation at a certain level mostly renders us oblivious of the activity at other levels. It is a matter of perspective[245]. Our preoccupation is on our current paradigm or immediate environment. And Emmeche aptly sums it up this way,

> *If you only existed at the microphysical level, you would never be able to identify the macrophysical phenomena. And this is one of the large facts in favour of emergence in contrast to the hard reductionists and eliminativists: the fact that it is impossible in these cases to interpret a lower level explanation without using some higher-level concepts to identify what is going on.*[246]

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[243] Emmeche et al, 1997

[244] Emmeche et al, 1997 p. 14

[245] To quote Morgan, 1997 p. 217, "way of seeing become ways of not seeing."

[246] Emmeche et al, 1997 p. 15

That inability to adequately understand the higher level from a lower level perspective does not, however, imply a lack of impact lower level operations on the higher. It is just ignorance. It is not a separation. An unawareness of macro-physical phenomena does not imply non- influence of the lower level on the higher. On the contrary, the contribution of microphysical phenomena on the macro-physical is a phenomenon that is significantly characteristic of complex phenomena. These individual units on the micro scale may not be linked by any common characteristic but nevertheless comprise parts of a system.
In Emmeche' et al's view, it is still important to understand the macro-level, to pick the pattern. If we start at the micro-level, we may not get the picture. In other words, explanation is ideally top-down,

> *...but any explanation of a recognized higher-level phenomenon must start with the higher-level phenomena to identify what to investigate thereby using some identification of the process or object. ... This very identification can never be totally discarded in a lower-level explanation, because in the ultimate through-and-through lower-level explanation one might never know which higher-level phenomenon it was an explanation of.*
> *We identify the micro-level based on the macro-level it helps us identify deterministic processes.*[247]

3.5 The Function of Information

The function and behaviour of information in complexity has an irony. In linear and mechanical reasoning, availability of information brings an assumption that one knows enough about a system to make deductions or even predictions about it. In other words, information can provide an idea of determinants and consequences to a system. In focusing on the primary level, within complexity and emergence however, the foregoing, by Emmeche et al's explanation, is not the case. There is still a difficulty in foreseeing the result based on the information at hand:

> *The drawback in the idea of "primary" emergence is that it is by no means evident that the emergent process itself contains information about how "big" the resultant class of new objects is going to be.*[248]

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[247] Emmeche et al, 1997 p. 15

[248] Emmeche et al, 1997 p. 7

This is a contrast to traditional Newtonian, mechanistic or linear processes' explanation. This incapability to predict system behaviour increases with the amount of information and consequently spells uncertainty.

> *In systems considered perfectly deterministic...an unpredictability is at issue which is not tied to the observing subject's lack of power to obtain information about the single elements of the system. No matter how much information obtained, the behaviour of the system will still be unpredictable after a certain lapse of time - the uncertainty of the information about the system will grow exponentially in relation to the uncertainty on the initial conditions...*

Even the explanation of DNA information acting to determine life form has limitations. The requirement is to consider factors other than its chemistry.

> *Even though DNA is a macromolecule, its role as carrier of information is not entailed merely by its chemical constitution. It follows that life is irreducible to chemistry... It would be not only impossible in relation to your actual knowledge*[249]*, but in principle impossible (regardless of your knowledge) for computational reasons: to determine which possible chemical combinations possess life-like properties,*

Emmeche et al. in asserting the irreducibility of life[250] here demonstrate another instance of emergence and levels, a theme in emergence we dealt with earlier. Although life, in this case is considered to have emerged from chemistry, it is impossible to reduce it to chemistry and work out any scenarios even with the best knowledge about the chemical constitution in the DNA of a life form.

3.6 Levels and their Relationship

The discussion above on some of the key parameters on emergence, namely creation, predictability, determination and function of information have laid some foundation to enable an understanding of emergence in Emmeche et al's perspective. This section and the next will focus on two critical descriptions of levels and supervenience.

Emmeche et al. handle levels in their thesis and distinguish that this problem was not addressed by Morgan[251]. Therefore, the discussion on levels is thematic in Emmeche et al's

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[249] The inference here is not knowledge as in "capacity to act", in proper definition, but information known.

[250] That is, to chemistry. The insights here have a significant basis on Polanyi's work. Goldstein, 2012.

[251] Who addressed "emergence" as "emergent evolution"

conceptualisation of emergence and was closed a previous section when “micro-level” and “macro-level” distinctions were quoted.

The discussion of levels may be related to that evolution. This is hinted in the descriptions of evolution in which the emphasis is on the word “development”[252]. This means that Also, complex phenomena evolve from simple phenomena over time. Complexity is derived from the simple and then there is remarkable modification.

> *The higher levels are as ontologically pre-eminent*[253] *as the lower ones, even if being presupposed by them, that is, they are defined by properties by special cases of the lower levels. In this respect, levels are ontologically parallel, but non-parallel in so far as they coexist.*
>
> *The higher levels are as ontologically pre-eminent as the lower ones…*[254]

The levels are equally ranked. We cannot talk about the higher level without dealing with its relationship with the lower.

> *The specified levels are inclusive in the sense that a level which has evolved at the basis of another is not able to change the laws of the lower level.*[255]
>
> *...levels are ontologically parallel, but non-parallel in so far as they coexist.*[256]

In other words, levels fit a unique epistemic description even though they are related and interdependent. Change and influence is, however, one directional. We have seen, above, that this should not be interpreted to mean predictability.

Emmeche et al. provide an example of this using physics, as a subject, and its relationship with other subjects. A further point, seen in the quote below, is that, even though in is not recognisable, properties of the upper level are already existent in the lower level. Operating at the lower level, one may not realise the existence of these.

> *The further consequence for physics is that it ceases to be identified with the science bearing this name to-day: the so-called "physical" description of a particle is not exhaustive, because a really exhaustive description would*

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[252] Emmeche et al, 1997

[253] Pre-eminent means the exceeding of others in quality or rank; of outstanding excellence, extremely notable, or important.

[254] Emmeche et al, 1997

[255] Emmeche et al, 1997

[256] Emmeche et al, 1997

> *contain a description of the possible combinations of the particle with other particles to larger entities, for instance biological, psychological, social ones.*

In other words, higher level entities cannot be described without accommodating descriptions of lower level entities. To be comprehensive in describing an entity, one must include a description of what makes it.

> *As Fink states: "A certain knowledge can be the condition for another knowledge, but it is not because the first knowledge concern a deeper, and the second a more superficial level in nature" (Fink 1990 p. 37). Whilst this point of view entails the seemingly reductionist consequence that biology is part of physics, it consequentially also must make room for the opposite idea: what we used to call physics is already biology, even if it is biology in a rather restricted sense.*[257]

In illustration, physics, therefore, is not self-constituted[258] but carries within it descriptions from other subjects. It must, when described, contain elements of other subjects in the description. So then, one "knowledge" has become a condition for another[259]. There is no inferiority but relationships. There is supervenience and no reductionism. This is because, in reductionism, we can always operate forwards taking apart elements of a phenomenon and still work backwards to reconstruct without loss of function, material or form. There is to be a method that sets the standard on how we can distinguish lower levels from higher ones.

> *The concept of levels is for instance implied in the preceding distinction between global and local processes. When we say that physical processes are global and biological processes are local, the implication is that physical laws are identical all over the universe - the physical level is the most basic level, from which all other levels arise.*[260]

and

> *Now primary levels will be the levels whose entities are central to a large population of higher levels.*[261]

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[257] Emmeche et al, 1997

[258] Colloquially, it is not made of itself!

[259] Emmeche et al, 1997

[260] Emmeche et al, 1997

[261] Emmeche et al, 1997

This is not to say, of course, that a level remains lower or higher or lower in all regards. When it determines another, it qualifies as the lower and if it is determined it is a higher level. This is insightful to deal with Emmeche et al. postulation of levels. It seems as key to understanding their thesis. They cite it as a hypothesis that is "stimulating".

> *In our discussion of levels, we find it a realistic and stimulating working hypothesis to concentrate on four primary levels - the physical, the biological, the psychological and sociological.*[262]

Emmeche et al's postulation of levels emergence recognises a four-primary-level ontology, being, physics, biology, psychology and sociology. In their narrative, we deduce that a level of emergence above another is composed by the one below it. Interestingly the entity that is below another level already bears elements of the upper level. We find this to be an irony of relationships[263]. There is therefore a scaling in the levels and entities. There is difficulty in determining a clear line separating two levels. There is, it appears, a seamless boundary.

3.7 Supervenience as Relatedness

Dealing with supervenience in the concept of emergence serves to emphasise, amongst other purposes that emergence is not nor does not imply direct / efficient causation[264]. Emergence, it seems, is a case of tracing preconditions and relationships of phenomena.

The discussion on supervenience was anticipated in our discussion on levels in the discussion of the relatedness of levels.

Emergence speaks of the assumption of qualitative characteristics by quantitative entities. Each time we regard emergence, we must consider at least two levels, one graduating from another. This must not be understood to mean that they exist separated by time as Emmeche et al. caution when they say we must "avoid parallelistic interpretation"[265] and "when the level is constituted it does not exist in parallel. Levels are inclusive in that respect"[266]. There is an association. One, the lower, has been transcended by the other whilst they co-exist in a dimension of relatedness. So, emergence "is among other things the concept which relates

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[262] Emmeche et al, 1997

[263] Dealt with in section 3.7 as "supervenience".

[264] An explanation of the elements, factors or determinations of a phenomenon.

[265] Emmeche et al, 1997

[266] Emmeche et al, 1997

levels to each other - or to be more precise, the concept which denotes the very passage between them"[267]. So supervenience is about relationships and extends to descriptions of how levels proceed from one to the other. Emmeche et al[268] describe this relationship as "the lower level has no sole responsibility in causing the higher."[269]

Supervenience separates emergent phenomena from the reductionist and mechanical notion of efficient causation. This is dispelled since it is not correct to state a single aspect as being the cause of another.

Emmeche et al's illustration is by way of using the relationship between sciences and saying that,

> *Borders between sciences must never be maintained rigoristically: we can never know if a given border can or cannot be transgressed by some empirical or theoretical result.*[270]

The caution is not to restrict the influence of one science on the other. It is a possibility that a connection or relationship exists. Which leads to Emmeche et al saying,

> *Higher levels are ontologically pre-eminent at the lower ones, even if being presupposed by them, that is, they are defined by properties by special cases of the lower levels... levels are ontologically parallel, but non parallel in so far as they exist.*[271]

There is stress on the higher levels which must not, whilst being in the foreground, overshadow the fact that they exist because of the existence of the lower levels. The lower level entities determine the higher.

Emmeche et al then observes that:

> *Regardless of whether the unity or disunity of science is sought almost all agree that someone or other version of a supervenience relation between higher- and lower-level entities exists... Thus, those who adhere to disunity,*

[267] Emmeche et al, 1997

[268] Emmeche et al, 1997

[269] Emmeche et al, 1997

[270] Emmeche et al, 1997

[271] Emmeche et al, 1997

> *nevertheless, recognise that the different levels of reality are necessarily, connected*[272].

Emmeche et al seem to be suggesting that even if there is no objective to relate sciences and a ritual to treat them as separate, it is possible to find relationships. They seem to suggest that relationship even for cases where phenomena operate in separation as may be perceived from a mechanical perspective.

Supervenience, therefore, is the relatedness of properties of the lower and upper levels. And Emmeche et al. state this about lower and upper levels

> *They are created in interaction and parallel with each other, and does (sic) not therefore evolve in a serial manner, as the biological in relation to the physical.*[273]

In describing levels, an irony manifests about their relationship. First there is interaction during their creation. This may imply some determinism of one on the other. There is interdependence at creation. Secondly, there is parallelism about the levels. They exist distinctly.

The irony is therefore in the interaction and parallelism. In complexity, this phenomenon does not seem to be rare. Entities may relate but still exist in autonomy but simultaneously without any implication of efficient causation

> *...if the higher level consists of units of the lower level, then they exist simultaneously.*
>
> *But this indicates that the relation of supervenience is not a case of efficient causation. The type of cause making the higher level exist is a special arrangement of the units.* [274]

The matter of efficient causation as a theme is overwhelmed by the explanation of supervenience in complex systems. This weakens the argument for linear notions that view causation as proceeding logically from a level to another. Emmeche et al's assertion here is a huge rebuttal to mechanistic causation.

> *That levels are inclusive means that a higher level does not violate lower level laws, that the higher level is materially related to the lower one, and that this*

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[272] Le Boutillier, 2003

[273] Emmeche et al, 1997

[274] Emmeche et al, 1997

> *does not imply that the organizing principle of the higher level can be deduced from lower level laws.*[275]

Supervenience is a matter of relationship not causation, since "there is no natural distinction between cause and effect. The two are parts of one and the same process."[276] There is clear irony in this. Seamlessness is a feature in how one can describe matters of cause and effect.

> *But all relevant parameters in the regularity of a process of cause is equally determinant for its outcome - and the upper level is in this respect as much part of the regularity as is the lower one.*[277]

Emmeche et al's philosophy for modelling levels is made clear in the foregoing that also lays emphasis on relationships,

> *Level constitution organizes primary entities into a new structure of relations… Now primary levels will be the levels whose entities are central to a large population of higher levels.* [278]

Their levels ontology, discussed above[279], models this perfectly. Physics, as a primary level, has entities instrumental in the development of biology and so forth.

3.8 Borders in Emergence

It is may be sensible to succeed the description of supervenience with a discussion on borders. At face value, and having dealt with supervenience, it may seem contradictory for Emmeche et al to employ the term "borders" to in the same thesis. The theme therefore deserves some exposition in how it is brought into their Emmeche et al's theory. Emmeche et al say that "emergence is at stake at the borders between the large sciences."[280] Their view is to doubt any argument that stresses the existence of clear boundaries within complex phenomena. It is assumed here that this refers to a separation between two levels of reality: "rigoristically: we can never know if a given border can or cannot be transgressed by

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[275] Emmeche et al, 1997

[276] That is, direct causation.

[277] Emmeche et al, 1997

[278] Emmeche et al, 1997

[279] See section on "levels above".

[280] Emmeche et al, 1997

some empirical or theoretical result"[281]. A fitting illustration they provide is that of levels in biology:

> *It seems intuitively correct to talk about for instance biology as one coherent field while at the other hand this field seems to be internally subdivided into a lot of levels also defined by emergence.*[282]

And further,

> *Differences may be objective - it is no subjectivist or purely epistemological point of view - but they are always relative to other relations of similarities between the objects compared*[283].

The absence of seamlessness may therefore be confined to mechanical notions and not complex ones. There will always be a factor relating phenomena at distinct levels. So, "the levels exist ontologically (and materialistically/realistically), but we might never be able to say where exactly the borders are"[284]. Because of this view, the notion of borders in emergence is sensibly an extension of the one on supervenience.
A clarification of levels and supervenience and borders will be succeeded with that of the gestalt and pattern making in Section 3.9.

3.9 The Gestalt and Pattern Making

The gestalt view, recalled by Emmeche et al in their text, exposes a micro-macro relationship between levels of emergence. It is almost like a mosaic and expressed as "the higher-level manifests itself as a pattern or as a special arrangement of entities of the lower"[285]. The entities of the lower level work to compose the full picture of the higher level. The phrase "special arrangement" must be qualified. The adjective "special", addresses a respect of factors obeyed by the lower entities. So, it is not a "disorderly" process. It is governed by rules that order the system. In explaining this, we may say that if disorder manifests, it is a perception of an observer who cannot see or even foresee any outcomes in the process.
In "arrangement', we can deduce that Emmeche et al. are saying that parts are set up in a format. The emphasis is on "pattern'. Patterns give shape, form and structure to the whole.

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[281] Emmeche et al, 1997

[282] Emmeche et al, 1997

[283] Emmeche et al, 1997

[284] Emmeche et al, 1997

[285] Emmeche et al, 1997

The full picture at the higher level does not readily manifest the contribution of each constituent.

One way of viewing a gestalt within emergence is to regard it as a paradigm. It is a view of the whole.

> *If you imagine yourself existing on the lower level you would hence not be able to realize or grasp the pattern which is only possible to conceive of at a higher level.*
>
> *Many - if not all - emergent phenomena shares this gestalt property of being a pattern in time and space of elements of the lower level.*[286]

The Gestalt is a parallel view of a complete, total whole on the upper and complete, total whole on the lower. It is however not all gestalts that show emergence. Reproducibility appears to form part of the criteria.

> *Still, on the other hand, pattern-making itself seems not to be enough to fulfil the requirements of emergence (many patterns, even if objectively existing and discernible by for instance neural networks - for instance ornaments - can be constructed which are not evident examples of emergence); emergence seems to require patterns whose stability and reproducibility over time is assured by self-organization.*[287]

3.10 Intersubjectivity / Objectivity: The Shaping of Reality

An important theme Emmeche et al. touch on, in a discussion of kinds of levels, is that of "intersubjectivity"[288]. Intersubjectivity may address the human dimension of supervenience since it appears to explain the relationships and how they shape reality. "Shape" has synonymy with "pattern". The Gestalt view, which was addressed in the section before has a strong focus on patterns.

In a social system, we identify the role of the self, the self's perception and ideology as it works alongside others. Individuals communicate their aspirations and views to others, who also have their own aspirations and views.

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[286] Emmeche et al, 1997

[287] Emmeche et al, 1997

[288] Emmeche et al, 1997

> *[M]an's specific defining feature seem to be self-consciousness, intimately related to language acquisition, to the possibility to transcend the local situation both spatially and temporally, and again to intersubjectivity.*[289]

We see that what people think not only has consequences to their reality but to their peers and society. There is a relationship therefore between the dimension of thought and that of society. Society informs thought or self-consciousness and thought. In turn, self-consciousness and thought bear on society.

> *Intersubjectivity and language are necessary for both self-consciousness and institutions. We thus have to see the development of the psychological level and the sociological level as interconnecting.*[290]

Some writers[291] go as far as regarding intersubjectivity and society as the same notion. Once we start dealing with society and breach the subjective or individual dimension[292] we move into considering objectivity, which is a social criterion for plausibility, truth and reliability. Shared notions must pass the objectivity test. It is perhaps a credible proposal to state that objectivity is a result and goal of intersubjective processes. Emmeche et al. may be implying this same idea when they state that,

> *But if form, structure, relation, Gestalt etc. are no longer considered as subjectivist features, but rather as objectively existing then form and matter may unite as equally objective.*[293]

3.11 Primordial Soup, Trial and Error Period

The insights in this section are a further example of how Emmeche et al. draw from other theorists to explain emergence. The hint on the influence of evolution in their theory comes from Morgan's statement they recall in explaining his "emergent evolution"[294] that "at a certain point in the evolutionary process, the dialectical development will cause quantitative

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[289] Emmeche et al, 1997

[290] Emmeche et al, 1997

[291] For example, Smith and Husserl, 2012

[292] These are mindsets, opinions and thoughts of the individual.

[293] Emmeche et al, 1997

[294] Emmeche et al, 1997

elements to synthesize into qualitatively different elements"[295]. The influence of Polanyi, Darwin and Morgan[296] rings clear in their ontology.

There are crucial lessons in the treatment of the notion around the "primordial" soup that deserves this distinct section. Emmeche et al. pick on the phenomenon of the primordial soup[297] and liken it to an "anlage"[298]. "The life-constituting process in the "primordial soup" is a very time-consuming process[299] (where)...one form wins[300]." One quickly recognises the resonance of this phenomenon with Darwinism or evolution which Emmeche et al. confirm when they say, "the constitution of a primary entity presupposes a time consuming 'Darwinian[301] trail-and-error' period"[302].

The foregoing appears to contrast emergence from reductionism in that predictability is not possible at the initial stages but there is movement towards systematic functionality that could not have been guessed at the onset. The process, in this case, has factors that limit the ability to compute which life form will proceed from it. These range from complexity at the onset, boundary *conditions* and time. The life constituting process, being non-linear has the possibility of creating a range of outcomes. The relationship of the process and emergence then comes together and is effectively rounded up as follows by Emmeche et al:

> *The primary emergence of a level of living systems on earth consists of (a) the emergence of an entity, a living cell with DNA, where the genetic information in the DNA constitutes the constraining conditions for life on Earth (the "boundary conditions" of Polanyi 1968), and (b) the subsequent of the (ecological, physiological, genetical, etc.) relations between various versions of the primary entity.*[303]

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[295] Emmeche et al, 1997

[296] Morgan, 1922

[297] A combination of many elements that is suggested to have been at the earliest stage of the formation of an organism

[298] An anlage is the primary cluster of embryonic cells that forms a body part in the gestation process.

[299] Emmeche et al, 1997

[300] Emmeche et al, 1997

[301] Of or Related to Charles Darwin's theory and especially about his notions of evolution and natural selection.

[302] Emmeche et al, 1997

[303] Emmeche et al, 1997

There are, in this summation on Polanyi[304], two necessary phenomena for emergence. There is the entity itself complete with the conditions that are determinant and these are alternatively called "boundary conditions". The second phenomenon is the group of factors within which that unit or entity exists which have a bearing on its functions, processes, and state.

3.12 Conclusion

This chapter opened with a discussion on how Emmeche et al. separate emergence from mechanistic materialism and reductionism. Mechanical determinism claims supporting notions of direct causation fall short of explaining a lot of phenomena. This enables a view of emergence as an authentic scientific notion worthy of study, focus and application.
Emmeche et al's conceptualisation of emergence seems to enable a wide material and immaterial application. They remark that instances of emergence are countless. Emmeche et al's theory emphasises *levels*, their relationship and the dynamics of these relationships.
Levels are related in a form that Emmeche et al. describe as supervenience. This implies the lack of inferiority and reductionism in the distinction of levels that are higher or lower.
Although each level distinctly exists, it is related to others bears on the other levels. In other words, there is a form of determinism. There is determinism but there is also potentiality. The entity has the capability to become something else because of processes and/or time. There is information available about the entity but there is incapacity in determining what it means on the progression of the process.
Borders between levels, due to supervenience, are not distinct. Border distinction may be confined to mechanical notions and not complex ones. Complexity means that there is always a factor linking phenomena at distinct levels. Since there is a relationship between upper and lower level phenomena, it is possible to view entities as wholes, or gestalts. The phenomena present as patterns or wholes.
Emergence is related to holism. An emergent entity has holistic behaviour. Societies represent the phenomenon of the gestalt. Subjective or individual consciousness interacts with notions that are objective and pertain to the social system that has plausibility, truth and reliability as criteria. A level is reliant on the level below it. The life constituting process, for instance, has conditions that curtail and sustain life. The process, long-drawn, is therefore one

[304] Goldstein, 2012

that determines extinction or survival of life forms.

If emergence is to form a model for a process or processes, we should require a refined set of conditions extracted from Emmeche et al and Polanyi's conceptualisation of emergence. Below are conditions that may be stated:

1. Firstly, there should be found relatedness of the levels
2. Dynamism must be a feature of the system. This should also entail significant consequences from small variations or tweaks
3. Relatedness of levels and the difficulty in distinguishing seperations
4. A pattern emanating from the special interaction must manifest but is should not be apparent when regarding the "components"
5. Objectivity must be a feature of the system. The system works as itself and responds to its reality
6. There must be a difficulty of top-up explanation against top-down is a hallmark of emergent phenomena. The possibility of linear explanation, an opposite of this feature, is typical in mechanical systems. This is either an inability to explain the top up effect using current knowledge but ability to explain top-down or the inability to do both (innovation may deal with the former).
7. There are two forms of processes it has been applied to in the above conceptualisation by Emmeche et al. The first can be understood to be phenomena we cannot clarify using our current knowledge. We can pin their determinants but cannot reasonably spell out the interactions that finally give rise to a phenomenon which presents. The second form, lies outside our ability even to define the determinants.
8. There is interaction during their creation. This may imply some determinism of one on the other. There is interdependence at creation.
9. There is no single aspect acting to causing of another. There is independent agency by each aspect even though it has influence on the other aspects.

Chapter 4
Summary of Themes

4.1 Introduction

We explored innovation in Chapter 2 and concluded, amongst other findings, that innovation is aimed at improving delivery and adding value. Innovation was determined by numerous factors to qualify as being complex. Influence of social factors, whether in its processes or adoption was also highlighted.

In Chapter 3, the conclusion after analysing Emmeche et al's perspective on emergence, emphasised the phenomena of supervenience, relatedness and uncovered two processes that qualify for emergence.

This chapter synthesises the insights of the second and third chapters into a couple of themes. To structure the discussion, and to allow for better deduction in the closing chapter, the discussion has been split into six groups of related or contesting themes. In each one, a condensation is made of the content from previous chapters. The objective in each case is to relate emergence and innovation. It is certain that, another author could have chosen different themes and perhaps formulate them differently, but the idea here is to take together six angles that may help us with an overall answer as to the role of the concept of emergence in thinking about innovation.

4.2 Systems and Innovation

In the "open innovation" notion, the internal organisational system is rendered prone to the influence of external factors and the resultant interplay yields a product which, in theory, is much more refined than in closed systems. There is benefit in viewing the open innovation notion as a complex system whilst contrasting it with closed innovation. Closed innovation systems may be viewed as mechanical and bearing little complexity.

In analysing the DIM, there are diverse types of adopters in the adopter unit and there is no certainty about innovation. The early adopter unit group has heterogeneous qualities. It is a group composed of distinct individuals with variant yet complementing behaviours,

characters and roles. Each a system[305] and determinant to different degrees, they in turn form part of the early adopter system in this crucial stage of innovation.

Weick also calls organisations tension systems to bring out the fact that participants in them are not always in agreement. They have opposing interests at certain times. This tension, whilst denoting conflict and systems within the bigger organisational system, is a sensemaking opportunity and this extends to a dialectical creation of organisational realities. Not only is there an effect by the environment on the organisation or group, the organisation and group are also affecting[306] the environment. This stresses the assertion that innovation is a significantly dialectical[307] concept.

The phenomenon of knowledge assets requires consideration in system terms. The creation of knowledge systems is never from "first principles". Individual backgrounds act and inform the process. These backgrounds or experiences are positive or negative. They have a bearing on the design of knowledge systems. This creates a management problem: in our intention to shore up what will be useful in future innovation process, are there any guidelines on what to preserve? Is it possible to design some criteria for this with guarantees for its endurance of changes in technology, for example? Is it possible to avoid "hoarding" of influences[308]?

It is possible to draw parallels between this depiction and Chesbrough description of open innovation wherein internal systems, in an interaction with those that are external, produces novelty. It can be suggested then, that a marketable product, idea or innovation is a system of systems and a whole.

There is another way of viewing systems in developing an understanding of emergence with innovation. Weick calls organisation tension systems. He implies, in this characterisation, the fact that there is often little agreement in this entity that still is expected to act as a unit and yet, also, for our purposes, create and innovate. The regard, also by Weick, of organisations as "sensible' environment is also metaphorical.

There are further characterisations, still metaphorical, we traced through our analysis. From the comparison of organisations to organisms in the metaphor of Morgan's. The organism is a systems notion.

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[305] Innovations are the outcome of several other creative processes and these are systems in themselves.

[306] Effects must be understood as being both positive and negative

[307] In the sense one phenomenon affecting the other in reciprocation

[308] That is, allowing too much influence of those aspects that will have a qualitative impact on innovation.

Boisot's Social Learning Cycle is also complex systems view as is the metaphors of viewing an organisation of Morgan's.

Throughout the above descriptions, there are notions of complex systems depicted. There is also entrenched creativity, scaling and levels since the interaction of inputs, conversations, conflicts and environmental factors yield novelty. In these phenomena, we discover emergence at work.

4.3 Predictability Vs. Control

Uncertainty can be perceived as being double barrelled. Its first connotation may be seen to apply to the indecision by an adopter in the DIM due to lack of comprehensive information[309]. This paralyses decision making and is dealt with in a section alongside information and complexity.

Its second notion may apply to a characteristic of complex systems and is related to our inability to say what a system's status will be like in future. It is related to information but in the sense that there is too much of it and there is no easy computation on how information sets will interplay in determining the system.

Our desire to know more about a system is a predictability[310] problem. Predictability is associated with control[311]. When we can "predict" a phenomenon, there is the comfort in our ability to plan for or about it. It appears the factor of information has some consequences in the innovation process or its diffusion or adoption.

There appears to be a concurrence by Snowden with Weick in this sensemaking notion with regards to patterns and logic in the system with respect to time. The current state is a pattern and one of the numerous possible outcomes at the initial stages. Like Boisot, Snowden locates organisational phenomenon transitioning[312], through time, in a dimension of unpredictability. It appears to widen the field of theorists who point out to the unpredictability of organisational systems.

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[309] This is the same uncertainty referred to when dealing with markets for instance.

[310] Predictability is a quality that rates how much awareness an observer has about the behaviour of elements or the likely consequence in the interaction of elements in a system or process. Understanding the explanation to refer to awareness of a result encroaches the province of mechanical phenomena and this is outside the scope of this theme.

[311] To be understood as the ability to intervene on the course of a process for changing or determining a result or results.

[312] Our reference to "organizational transitioning" goes beyond the various forms of business innovation described in Chapter 2 and extends to other forms as would be found in social innovation processes.

Our understanding of unpredictability must not be to be uncomfortable about an outcome but a satisfaction that even a phase in the process that seems out of place, which creates the unpredictability, is still a feature giving form and a pattern. A view of innovation within the framework of emergence would denote an acceptance of innovation as bearing an unpredictable quality at certain stages. This should adjust the view of innovation as being a planned and controlled process for the most part.

4.4 Information Input, Monitoring and Time

Related to control and predictability is a desire for significant amount of information about a system. This desire, ironically, almost always entails growing complexity in our understanding of the system. Our intention in seeking data and information, when we monitor the possible number of indicators, is to increase our understanding about the system but suffers a from the pitfall that as information increases, so does complexity.
Management must, as this appears obligatory, provide details about innovation because in the scheme of organisational systems, there must be sufficient detail to enable accountability of action and cost to facilitate audit and learning processes amongst other reasons. At the conceptualisation or realisation for the need to innovate, there is excessive information or detail to work with. This gives rise to uncertainty about the innovation process.
Uncertainty itself is a desirable phenomenon from a risk management point of view. When it exists, it enables scenario planning[313] and assists in strategy formulation. It therefore is necessary, in this sense, to embrace it. That initial uncertainty is not a concern as has been discussed. It is a means to an appropriate result.
The preoccupation must be on meeting the requirements of adopters by regarding the information input. Having something new is about generating value by having an adoptable result. It is one that the target group or population can adopt. Of course, a significant consideration must be given to late adopters. This is to say that there must be measures to ensure quick adoption by those who wait for more information to affirm the innovation process. The idea must be quickly assimilated by most the population or adopters.

[313] A strategy tactic that entails the consideration of different circumstances or events and deciding on the response appropriate for each one. In scenario planning, the strategist is interested in preparedness and having multiple options because of uncertainty or unpredictability.

Information also appears to be a common denominator between innovation and knowledge management. It can be suggested that innovation is one of the key ideas regarding knowledge management. It is

1. A source – innovation provides information for knowledge management processes
2. A beneficiary – in the sense that information is an input in innovation processes
3. A determinant – innovation processes determine the nature of knowledge management
4. An enabler – innovation provides for knowledge management

Uncertainty, a key marker of emergence, is an inevitable aspect of innovation.

4.5 Pluralism: An Innovation Problem?

An organisation's customer base is usually an array of individuals with different perceptions, paradigms and processes. Viewed in another way, they are systems that interact with an organisation's in the innovation process. External systems, at the customers' whim, are inputs, in their multitude, to the organisation's creative processes.

This same notion is reiterated in Chesbrough when he presents his description of the open innovation concept. Working with this concept, a firm will expose itself up to the inputs of its stakeholders and markets and allow that relationship and interaction to modify its technology, processes and so on. Here, there is heterogeneity in that multiple sources of input exist.

Another way to perceive most forms heterogeneity is to regard the phenomenon in information terms. To be certain, a unit that has heterogeneity is characterised by the exchange of significant information. This phenomenon of information was dealt with earlier in a section 4.4.

There is little chance of various participants in the unit or adopters, even early adopters, to be unitary. With some consideration on circumstances, this may be used to an advantage but the management skill that is demanded for that to happen is rare. This notion is implied by Snowden[314] and Holland[315]. The concern is whether such skill can be imparted. The suspicion is that it is intuitive, tacit and acquired over a painstaking amount of time.

[314] Snowden, 2002

[315] Holland, 1998

An example of how heterogeneity can be used to advantage is with the irony of Emmeche et al's project when we note the relationship between their project and the subject they tackle, emergence. They have drawn from several authorships like Morgan, Darwin and others and theories to produce a "collective" or comprehensive, multi-faceted description of emergence. Each collective network is a separate unit that participates in the formation of something new. In Weick's sensemaking, what takes form and shape is the organisational system. But it is also derived from and determined by other systems at another level. There is collective action directed towards creativity. But the realisation must be a multitude of factors or systems at play which we describe elsewhere as a control challenge and before this as one requiring rare management skill.

History can be viewed as part of this phenomenon of pluralism. It is critical to observe the characterisation of history, an input into the design process, as "baggage"[316]. This connotes bulky content that has useful/valuable qualities and some, not so. The problem, at the initial stages, is an unawareness of which aspect is worthwhile and which one is not.

The "Start-Up Life Cycle"[317] presents an opportunity to analyse the DIM graphically. It certainly would not be the way how innovations are funded, grow flourish or die most of the time. It comes close to trace the role of money in innovations. In true respect to complexity phenomena, the behaviour of the trend line depicted in the model would be different for each case. In fact, it is almost always difficult to determine the trend with accuracy because of the influence of multiple *enablers* bearing on the innovation. This is another dimension of variety.

Emmeche et al's treatment of creativity acknowledges a pluralism in their "make out of nothing" and inclusivity notion of the phenomenon. In acknowledging a self-regulation in the creativity notion, they imply a system's activity capable in itself. This creativity likened to a child in growth. Pluralism is therefore a creative feature. Pluralism is a catalyst especially in the open innovation paradigm. This is not to rule it out in the closed innovation paradigm. The existence of pluralism in the open innovation scheme is a condition that introduces emergence.

[316] Snowden, 2002

[317] (ECE/CECI/7) United Nations, 2009

4.6 Value as a Target

In this section, we will discuss some notions side by side because of their relationship. They are central themes in both innovation and emergence. We have brought forward Emmeche et al's conceptualisation as a "Darwinism-like trial and error process"[318] and assumed it to mean some evolution.

Emmeche teases us about objectivity. Our discussion, within Emmeche et al, revealed that objectivity has aspects of validation. An innovative idea must be a plausible emergent from a thorough process.

We should consider perceiving the "trial and testing"[319] period as the formulation of objectivity. This period is the "thorough process". The term "thorough" bears an irony. At first consideration, it brings notions of a careful plan for execution. The thoroughness in the scheme of creativity implies, surprisingly, some chaos and a "plan" may turn into an obstacle!

Objectivity is an important theme in evolution, and creativity. It is therefore crucial to regard it as a boundary condition in Polanyi's sense. It certainly is a factor for later adopters and investors as they seek to determine value of a new idea, concept or innovation and may "shallow" the "valley of death"[320].

Innovation viewed within the "Start-Up Life Cycle"[321] especially considering the "valley of death" suggests the subjectivity of in its process. The innovation process and consumers/adopters are at the "mercy" of those who can fund innovation. This plays out more like how media manipulates the public with information. A critical question when discussing "value" in innovation should be: Whose value is it?

We discovered also Rogers et al, in discussing the DIM, an inflection point as adoption starts to rise towards its peak. There are similarities between it and the inflection point[322] before the tipping point on his model's graph[323].

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[318] Emmeche et al, 1997

[319] Emmeche et al, 1997

[320] (ECE/CECI/7) United Nations, 2009

[321] (ECE/CECI/7) United Nations, 2009

[322] Rogers et al, 2004

[323] See Figure 6

The initial stages of any innovation have profound heterogeneity and resemble a "primordial soup"[324]. The various aspects, each of them being separate systems, determine the process as enablers. Because these aspects are systems, they are functional and have objectivity in their own regard. This objectivity extends to the way these systems interact. Objectivity is the most prominent attribute of properties at the lower level in emergence. In the innovation process, a goal or target or objective exists. The final state or structure is always a mystery from the start. What seems critical is the identification of a target as we learnt from Holland. Thereafter a filtration-like process takes place on the way to the "final" state. "Final" because the process of finding value is never complete.

Filtration occurs through a process of people deciding on value. Value decisions, which we saw under DIM, may be analysed as processes of filtration. They determine success, the rate or failure of innovation processes. Throughout, there are no rules set but voluntary actions involved. The "voluntary" theme is strong in the DIM and in. Individuals, as the components of society, determine the success of innovation, whether it is the process or outcome by their objectives. In other words, they allow what they value to succeed. At one end of this filter-like spectrum, are early adopters who have enough resources to experiment. On the other are late adopters who, not as "promiscuous", finally tip the scale.

An irony is implicit in the foregoing. Both early and late adopters perceive value differently. Since early adopters have adequate disposable resources, they can easily explore risk and new commodities without a great fear of loss. But their value is from an investment point of view. Late adopters on the other hand, opt for "tried and tested"[325] innovations that are sustainable in consideration of their low-affording, risk adversity disposition. They perceive innovation with a consumer's perspective.

The discussion on objectivity must be balanced with the role of subjectivity in the innovation process. It seems inaccurate to focus on intersubjectivity without pointing out those subjective processes, though hardly valid and struggling with plausibility, are mostly initial stages of intersubjective ones. This is made clear in Weick's social creation notion. Subjectivity has its place in creativity. When we seek to create new artefacts, we must interpret the world and create models that must be tested intersubjectively.

[324] Emmeche et al, 1997

[325] Emmeche et al, 2007

Value in innovation is a shifting phenomenon. It therefore ascribes innovation some level of emergence or renders innovation to be perceived as emergent as it moves from one composite form to the next, and one gestalt to another.

4.7 Creative Transcendence [326] and the Nexus

The phrase "creative transcendence" may not have appeared before this section. It however excellently describes a prevailing notion in several theories discussed in the previous chapters. The concept here is to extend the inference of the foregoing discussion. We will start with Emmeche et al's observation of virtual borders relating different fields separating them but causing their interaction. We introduced this phenomenon as supervenience.
Whilst dealing with Rogers et al' DIM we illustrated the diffusion of innovation using the graph in *Fig. 6*. The point before the inflection point is clearly lower than at the peak of adoption. Although there is a difference in the levels, the inflection itself is not really an acute turn. It is a curve, and this implies some gradualness in the "transformation" or adoption.
The phenomenon of heterogeneity in DIM has some characteristics of, and functions to illustrate, supervenience. It is that indescribable yet beautiful accommodation of variety, multiplicity and "multi-culturedness" it possesses that interests us. The interaction of differences facilitates creative transcendence from a scale or level to another with some smoothness more interesting than in homophilic environments.
If this point of inflection facilitates a shift, then we can describe it as being at the border. It is a nexus[327]. This zone should be celebrated as a region for insight that Holland cites. What is insight? It is the ability to see deep and beyond one's paradigm. In other words, a transcendence past the limitations of one's zone to grasp the mechanisms of the next, higher, new zone or work out how that next zone should be formulated.
Not only is there transition (or movement) in this phenomenon we are dealing with, there is some of translation. Early adopters are at this intersection and must almost equal those participating in the innovation process on their insight. Both groups must oscillate between old and new forms of a concept as they test and "taste" the new and contrast it with the old.

[326] Rabb, 2014. This phrase is used here with a slightly different connotation. It appeared to best describe the notion in two words!

[327] A zone that joins two sets; an intersection; the area that bears the characteristics of sides that are adjacent.

Weick's remarks about sensemaking, at a point, and in a sense, appear to relate it to supervenience. This is because the process of sensemaking works towards the creation of a composite picture. It starts at the subjective level whilst gravitating towards the intersubjective. It wants to fulfil the requirements of the "generic subjective"[328] level. This is composite and a gestalt.

In another dimension, it can still be argued, therefore, that since innovation is an open system, the spread or diffusion is part of the innovation process. An innovation is transformed and developed continuously. We can support this using the DIM. What is of concern is having a measure of readiness to adopt or innovate. It is a function of competence, resources, culture and other factors we discussed under Dey's enablers.

Supervenience is one reason why we can never "feel" evolution and let alone predict it. It can only be historically perceived when we work to analyse what is emergent at the global scale and attempt an explanation of prior processes. We cannot, however be accurate about what caused it. This is because, as we prefer to view the processes as complex phenomena in their typical tradition, we can never attribute the outcome to direct causation. Innovation is a process dependant on the exploitation of relationships between multiple concepts at distinct levels.

4.8 Summary

Several theories had been discussed before the opening of this chapter. It was necessary to condense the debate into workable themes. The exercise also established emergence concepts within innovation.

Chiefly, innovation is characterised by systems that are complex. These manifest because of several factors that include those that are external and internal in the open innovation concept. The systems also extend to individual influences identified in the DIM for instance. The theme of systems within innovation must be considered, regarding innovation, in terms of how well they can be managed. Innovation exhibits unpredictability and uncertainty characteristics. This makes it eligible for perception as an emergent phenomenon. Prediction and uncertainty are inversely related to control.

Information presents a heterogeneity factor and increases complexity. It sophisticates management activity. On the surface, however, it is necessary to accumulate it to find a basis

[328] Weick, 1995

for decision making. This is the irony it presents. In this light, information must be a significant consideration when discussing prediction and control.

There should be an objective of extracting value from an innovation process. But value is a composite. It is the result of a thorough process targeting at realising a new reality. In this manner, the notion has connotations of levels and a requirement to impose some the realisation of benefits at a stage that balances investor concerns and thoroughness in the process.

The discussion of levels is incomplete without the regard of the interaction between them. That edge was identified as a zone of translation.

Chapter 5
Innovation and Emergence

5.1 Introduction

Chapter 1 stated an objective of this exercise as being to expose the role of complexity and, especially, emergence theories in organisational innovation processes using select literature analysis.

Innovation and emergence were explained in Chapters 2 and 3 respectively. Chapter 4 summarised the six major themes of the chapters on innovation and emergence as the first step towards a synthesis.

In this chapter we consider three possible positions regarding the relationship between emergence and innovation as an interpretation of the six themes in Chapter 4. On certain issues, it will be necessary to make references to the theories in Chapters 1, 2 and 3. The discussion will commence with three potential views regarding the emergence and innovation.

5.2 Three Potential Views

This section is an introduction to three forms of possible views or stances as a closing discussion of complexity, with a special focus on emergence and, innovation. Sections 5.3 to 5.5 will provide an assessment of each of these views. The sections will draw from the study to establish merits and demerits of each view.

The first possible view is of emergence as an explanation of the innovation process. We can paraphrase this or extend it in at least two ways. These are that (1) innovation is an emergent process and, (2) that we should be able to trace emergent properties within the process of innovation.

A second view, use the first one, above, as an assumption and considers emergence as a prescription for innovation. The suggestion is what one may call “application”, that is to say emergence is a template for innovation processes. This view likens emergence as a tool to use, prior to an innovation process, for setting out actions and plans that are aimed at achieving innovation. It translates it into a model or teaching tool for innovations and innovation phenomena.

Thirdly, there is the possibility of seeing emergence as a metaphor for innovation. A metaphor appeals to symbolism. It is necessary to differentiate this view from the other two views. In the first, the import is that innovation is an emergent process whereas in this third view, the desire is to use emergence as an analogue without claiming that it is necessarily the template for innovation processes. So, the third view is a cautious perspective and might also only apply to a part of the innovation process.

The discussion that follows considers each of the three views in turn in the sequence they were presented here.

5.3 Innovation as an Emergent Process

In the systems consideration in Chapter 4 and especially in the open innovation concept, the internal organisational system is rendered prone to the influence of external factors and the resultant interplay yields a product which, in theory, is much more refined than in closed systems.

Working in the open innovation paradigm, a firm will expose itself up to the inputs of its stakeholders and markets and allow that relationship and interaction to modify its technology, processes and so on. Here, there is heterogeneity in that multiple sources of input exist contributing to the innovation process.

Rather than paying attention to metrics of factors that we can identify or input, complexity in innovation demands that we monitor closely the interaction and consequences of what see emerging. Hoarding is likely to occur at the creativity stages when a system is open, and this gives rise to complexity.

The early adopter unit group has heterogeneous qualities. It is a group composed of distinct individuals with variant yet complementing behaviours, characters and roles. Each a system[329] and determinant to different degrees, they in turn form part of the early adopter system in this crucial stage of innovation. Because these are different systems, they are what Weick calls tension systems and are dialectical in that they interact in their diversity.

There seems to be some noise and at a certain stage of adoption before mass adoption. This is one way of looking at the problem. The second is to consider this as an evolutionary concept, regarded as parallel to emergence, where the fittest concept will survive and win. This conceptualisation of innovation satisfies the Gestalt view wherein the bigger picture matters.

[329] Innovations are the outcome of several other creative processes and these are systems in themselves.

In discussing emergence and its appropriateness as an explanation for innovation and alongside our understanding of these two notions within the complexity theory paradigm, the refreshing discovery is the role of human cognition in the full scheme. It is at play as an influence within enablers, in the development of disciplines and levels, perceiving nexuses (subjective) and testing combinations (intersubjective), choosing building blocks inside the noise and chaos and in the process also discovering and realising upper level properties. Emergence is a promising idea to model dynamic and transformational organisational processes concepts. It however fails to account for the control that is necessary after convergence[330] when the innovation reaches maturity and must be primed for commerce or utilisation. Utilisation is perhaps what Boisot[331] describes as "codification".

Further, when we combine to the realisation of some significant phenomenon, whose is it? There are intellectual property implications that must be considered. The significant point is that, at a point in the function of organisations, innovative ideas must be "owned" through stabilisation by management. This means that accountability must be conferred, responsibility given, and control exercised. Whilst the distinction of this stage may be a vague phenomenon, a good consideration may be the role of money in creativity and innovation. We discussed this in the Start-Up Life Cycle. The other consideration, based on the ability to determine whether assimilation has gone beyond early adopters, is the DIM where it may be necessary to assess how quickly innovative ideas are assimilated by late adopters. Late adopters have a poor appetite for complexity.

We cannot deal with the entire process of innovation as an emergent phenomenon since a stage arrives when forms of mechanistic and reductionist activities are necessary to organise the result. The reasons for this include the necessity to take account of financial resources expended in the innovation, the need to give accountability and the fulfilment of obligation to shareholders, protection of the innovation or copyrighting and so on.

The problem the view is that the full scale of the innovation process is not wholly emergent. Some components, activities, tasks are reductionist. There is indeed significant uncertainty at the creative stages. The process must have structure as it concludes or to realise some benefit.

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[330] Used here to mean the consolidation and sifting of the many ideas coming from heterogeneity, pluralism and open systems into a unit that can be considered as the outcome to proceed with. This is a representation of the creative processes.

[331] Boisot, 1998

5.4 Emergence as a Prescription for Innovation

The proposition of viewing emergence as a template or design on how to design or support an innovative process should be considered. This is at least on the basis that organisations, obsessed with formulas, strategies and didactic instruction may desire a concrete and empirical way of structuring innovation processes. So, a prescriptive view may be appealing to certain organisation players.

A prescription is only possible when all the factors are known. A prescription is structured, based on known conditions and on controlled conditions. In a prescription, the course of action or activities is decided on beforehand. The steps are assumed as the best and the plan is assumed as best for the circumstances, present and predicted. Prescription introduced early or from the onset brings a predictability and stability at a phase where it is not desired in the innovation process.

The view that emergence can be used as a prescription in innovation is faulty in two respects. Firstly, it draws emergence into the realm of mechanical and reductionist notions. As if the concept can be usefully applied as a template. Secondly, from the standpoint of creativity, limits are introduced by the very nature of the prescription. The risks where a structured plan is introduced, openness is lost, creativity is minimised, and reductionism gained. We must still acknowledge that reductionism seems desirable to stabilise innovation and this is a notion explained and suggested in the other sections of this chapter. In the section below, there is an identification of the phase where it may be necessary to set structures and introduce stability in the innovation process.

Whilst open innovation is a prescriptive notion, as in: a strategy for innovation that is likely to work better than closed innovation and therefore recommended and allowed for, this does not mean emergence is. Stating that open innovation is recommended and citing it for fostering better creativity is different from “prescribing” emergence. Open innovation is an acknowledgement and celebration of the nature of complexity in organisational systems and therefore benefits from emergence.

The proposition that emergence can be a template for innovation casts a contradiction on the concept itself. It places it in the realms of reductionism and outside complexity.

5.5 Emergence as a Metaphor

A metaphor is symbolic of a target of study or perception. Morgan's[332] metaphors are useful for segments, parts of processes, from a viewpoint and whilst not representing the total organisational system, may focus on systems or their parts.

At the point when the need to innovate becomes clear, there is excessive information or detail to work with. In fact, innovation is easier in an environment that is information-heavy. Information is still just one of the phenomena presenting for consideration at this stage. We discussed these phenomena as present the characteristic of heterogeneity. Heterogeneity is also endeared by the influence of external input as in the open innovation concept. Heterogeneity also manifests as conflict and in fact make up what Holland regards as "building blocks". In this case, innovation becomes an emergent phenomenon of dialectical processes between aspects inside the organisation and those outside it.

Heterogeneity is catalytic and synonymous with emergence. Innovation may then be viewed as being a culmination of eclectic processes or systems. Heterogeneity, pluralism and eclecticism[333], in a considerable of cases, increases innovation ideas' appeal. The common perception of heterogeneity, is that it brings uncertainty in the innovation process. Uncertainty, within complexity, and beyond its being a hallmark, is not a concern as has been discussed. But multiplicity scares investors and late adopters. They are searching for certainty. But certainty is a form of value that is ensured by a thorough process. We can therefore state the irony that thoroughness is difficult to achieve or guarantee without heterogeneity. It is a means to an appropriate result. Uncertainty is beneficial, because it is really a sign of various kinds and levels of input bringing form.

In this dimension, rather than paying attention to metrics of factors that we can identify or input, complexity in innovation demands that we monitor closely the interaction and consequences of what see emerging as Snowden proposes. These complex interactions are where creativity in most likely. Creativity seems to proliferate in complexity. Emergent phenomena yield us value through creativity inherent in complex processes. That form, the certainty and value, should yield, at a certain point or at certain points, to a stability that can be sold. This is what organisational objectives, national plans, business is about. This speaks of another level in innovation.

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[332] A metaphor

[333] Used to mean: inspired by or drawing from various sources or theories.

The stable phase is what "management" is known to focus on. Management is known to be about extracting hard data, compiling statistics, making decisions, following plans and budgets. In other words, management is about control. Management must, as this appears obligatory, provide details about innovation because in the scheme of organisational systems, there must be sufficient detail to enable accountability of action and cost to facilitate audit and learning processes amongst other reasons.

Early adopters, closely bearing the characteristics of the innovators may not mind the instability and complexity on the development and introduction of a new product. But late adopters are attracted by stability and are unfortunately the majority of the adopter population! At a point, therefore, some stability must be guaranteed.

The view that creativity yields to control, iteratively and that emergence is pronounced within creativity is a fitting of this third perspective. At face value, this view of emergence as a model and metaphor for creativity appears to posit it as a feeble notion. This is from the obsession to formulas and mechanical notions. Complexity proponents may be comfortable with it since it posits emergence as a critical to creativity, which, in earnest, is the bedrock of innovation. It also allows the presentation of innovation as both open and closed, that is sensitive to stakeholders and environmental factors but also subject to management control.

Another metaphor is that innovation presents us with another way of explaining the interaction of mechanical reductionism, characterised by the stability we explained above, and complexity, a notion best explaining the instability within creativity. At certain points in the innovation process, especially at creative instances, emergence is exhibited and is a necessity.

This foregoing analysis was anticipated when we explained the problem of the first view that proposes innovation as being wholly emergent. This proposition seems to be the most viable view amongst those presented.

5.6 Concluding Remarks

This study enables the view that innovation is a notion that demonstrates that complex and mechanical or reductionist aspects can contribute to the realisation of organisational results. It advances the view that there can be a connection or collaboration between complexity and reductionism.

The complex aspects of innovation that were uncovered in the study reduce the obsession to place all innovation activities in the zone of control. Obviously, the extent of control and openness will vary from establishment to establishment and depend on the type of service or product that is the subject of innovation.

Creativity is therefore not for technical individuals or subject matter experts to act as the only participants in the innovation process. At points when uncertainty characterises process, this should be embraced as part of the process, cost and management control considered.

Notions of complexity and emergence may be among many useful in explaining creativity within innovation. So, on a macro-scale, a study such as this one is likely to shift perceptions on emergence and complexity from being mere theories and notions to them being utilitarian.

An implicit suggestion in this study has been to support, where this exists, the predominant definition of innovation. It is as "soft" as it "hard". Weick's "enactment", amongst other views, enables this assessment.

The reliance on one text for emergence in this study could have caused a narrow view of the notion. More insights could have been possible had more texts been analysed. The strategy of using more texts on emergence, on the other hand, could have had the result of complicating the study and creating a wider range of study material. The shortcoming of analysing a single text on emergence can, perhaps, be balanced by another study using a different text on emergence but addressing the same inquiry as this study attempted.

The wide spectrum on theories for both innovation and complexities created difficulties in the analysis. It was perceived that a reliance on only one or two theorists could have provided for an inadequate and poorly balanced analysis. It would have also only enabled a shallower conclusion.

Perceptions on the effect of using the number of theorists done in this study may be regarded by readers differently.

The strategy of doing a textual analysis and then distilling, for convenience, the lessons into the classification of themes in Chapter 4 is certain to have created some omissions. The

results from this strategy is certain to have created some bias. Whether a different strategy would have improved the validity of the "results", in another attempt, is worth considering. It is apparent that this qualitative study was a challenge to design for. The inquiry was still worthwhile to attempt!

To start with, creativity within innovation, as demonstrated in the previous chapters through the analysis of theories, points to an unpredictability of organisational systems. We must clarify that this unpredictability is not found throughout the array of organisational systems. There is a challenge in viewing the full innovation process as being emergent. The problem with this is that value is normally extracted within the circumstances of some control or mechanical processing. Some mechanical, reductionist activities, quite variant to emergent processes are necessary at certain stages. Said differently, innovation initially consists of divergence because of creativity (or the emergence of new patterns), but later must become more focused and convergent to ossify into products or services[334].

Subsequently, our discussion focused on the implausibility of proposing emergence as a prescription for innovation. This idea that innovation may be a template for innovation appears to be the least defensible. It has many faults and is the weakest of the three proposals discussed. This conceptualisation would be based on a misplaced notion that emergence is mechanical. Presented in another way, this gives rise to a problem diametrically to the first proposition, stated in the preceding paragraph. The greatest set-back in regarding emergence as a prescription for innovation is perhaps the fact that it is a concept that is useful in explanation. It is not a framework for planning the course of creativity.

The first view seems to hold some promise, whilst the second view does not resonate with the worldview of emergence, and the third metaphorical view seems to be the appropriate way to see the initial divergent phase of the innovative process. There is management of complexity before convergence and in the unstable and create phases of innovation and of reductionist and mechanical management close to a convergence, used in this section to describe the phenomenon where heterogeneity settles or unifies into a marketable concept. This may be argued as a process of self-regulation. It denotes another level, a composite or a gestalt.

Emergence in innovation is significant in at least two conditions. Firstly, it is significant before convergence, that is, in the unstable phase of the innovation process. Emergence is also significant within multiplicity or heterogeneity. We have not deeply dealt with heterogeneity in a dimension that considers the competence that interdisciplinary individuals

[334] Or in the language of emergence, a new stable level.

bring into the creative process. The closest notion to that discussion were Holland's view of "insight" and the interpretation Weick's explanation of the "subjective". If anything, this puts stress on two themes that received wide coverage. The first is that of heterogeneity. The other is that of "creative transcendence". Both "insight" and the "subjective" are unstable zones and represent emergent phenomena on their level.

A potential positive consequence of individual interdisciplinary combinations in creative work is the increase in appeal or flavour of the product. There is appeal, because each participant in the creative process draws and applies their experience to the artefact, and flavour, because each participant's "taste" is part of the product.

Wheatley and Friese have an exciting perspective on the foregoing:

> *Rather than worry about critical mass, our work is to foster critical connections...Through these relationships, we will develop the new knowledge, practices, courage, and commitment that lead to broad-based change... When separate, local efforts connect with each other as networks, and then strengthen as communities of practice, suddenly and surprisingly a new system emerges at a greater level of scale... Emergence is how life creates radical change and takes things to scale.*[335]

The type of control we find in dealing with complex phenomena is quite distinct from that in settings where mechanical processing is pronounced. We therefore retain a level of management ability and this means keeping very close watch on the emergent phenomena. It is management of a distinct kind. Management befitting emergent phenomena. Management that varies from mostly monitoring (of complex phenomena) and control when we know what gives value. Both monitoring and control can feature simultaneously, even focused on aspects of the same phenomena. This is due to multiplicity in most innovation processes.

It can be stated that:

1. We are unable to predict innovation,
2. Because innovation is eclectic, it can be said to be complex. Innovation is endeared by variety. Variety is what gives innovation its novelty and appeal, and
3. Enablers, on the other hand provide innovation the quality that causes us to say it is an emergent phenomenon at the creativity stages

[335] Wheatley and Frieze, 2006

So, the consolation is that, at certain points, if we are really concerned with control, there is an opportunity to manage. And still, even unstable phenomena are "managed" by insight, for example, in the manner Holland explains. It is also managed by recognising its complexity as Snowden proposes.

The overall assessment, then, is to assert that innovation has stages entail emergent phenomena and emergence is a metaphor of some creativity within innovation. Emergence is a characteristic of the unstable zones. Value and stability are the results of this emergence, amongst other factors. Emergence is a technical concept in complexity. It is a notion that explains the connection between various stable labels. This lays an emphasis on the edge, supervenience and the nexus. These should be considered as zones of high creativity and insight.

In proposing emergence as a metaphor of the instability in innovation, the real celebration emanates from the role of "creative transcendence". This is the concept positing the nexus as a zone of interpretation even though it has, and because of, uncertainty. The picture that is painted is stability and instability existing in a variety of systems in the unit. There is interaction of these systems on their edges. These interactions disregard time and space, can exist in the same or different section, department or sector and so on. The interaction can also happen at the same or separate instances. What matters is that they may be unstable or stabilised to benefit both creativity, as emergent phenomena, and provide value, as stable phenomena, respectively. Innovation can therefore be described as bipolar.

It is consequently not enough to find multiplicity. It is more viable to find where it coincides and converges into a stable, within-reach marketable entity. The unstable notions, the emphasis in this thesis, must be justly viewed as the conditions for creativity. Each system oscillates in and out of stability. An election process, from a contending party's primary election stage to inauguration is an illustration suitable for this description. In the build-up to a vote, there is turbulence, chaos and uncertainty. The process is nearly always stabilised in the period after the casting of votes. Rules and conduct of managing processes are clear and obscure in various phases of this system. Even in "stable" phases, there are normally signs that the turbulence, chaos and uncertainty will return. But each process, each cycle, is difference from the one before or after it. It ushers a new reality or a fresh level.

Emergence may be one of the best notions of explaining the creative phase within innovation within organisations.

Although it suffers a handicap that it does not accommodate the full innovation cycle, the advantage of positing emergence as a metaphor for innovation provides an opportunity to

teach innovation in a new way. That approach to view innovation as a process that features stability and instability. This binary view should not restrict itself to a linear process in innovation where the instability, comprised of creative activity that is an emergent phenomenon and the stability, marked by predictive and control-related activity occur in sequence. This may be the case. The preferred view should be to present an oscillation of both stability and instability within the innovation process. Since organisations are systems not composed of single event, it may well be that several innovative processes can take place simultaneously and be at various levels of stability.

The need to use different texts on emergence in a study with the same strategy as this one was addressed at the beginning of this section. Even though there has been a lot of research on complexity and emergence, there still seems to be some gaps in how it must be understood, defined and applied. Perhaps, a future study along the lines of the one done here will lead to different and even more interesting conclusions,

Respectively, Weick and Snowden's sensemaking and Cynefin Models present content that can be studied in light of innovation. They seem to offer an excellent opinion in analysis of the role of complexity in innovation. The two theories also have an appeal in organisational settings of different descriptions: political, commercial, community, academic and so on.

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