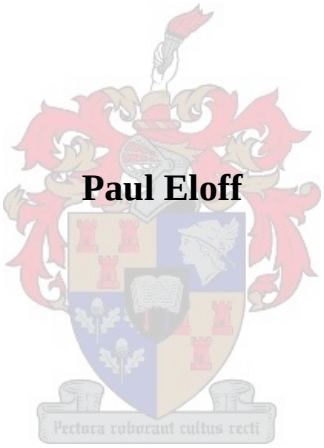
KNOWLEDGE EMERGING FROM CHAOS

ORGANISATIONAL SENSEMAKING AS KNOWLEDGE CREATION



Paul Eloff

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STELLENBOSCH UNIVERSITY

SUPERVISOR: Christiaan Maasdorp

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DECLARATION

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Date: 21 November 2008

Summary

Organisations find themselves in a world of ever-increasing rate of change. Increasingly organisations operate in what is known as the edge of chaos—that zone which paradoxically might lead to paralysis and disaster or to creativity and innovation. In this area of uncertainty, organisations rely on their ability to create new organisational knowledge. What is unclear is exactly how new knowledge comes into being under these conditions and what would count as new organisational knowledge.

The thesis tries to shed light on the process by which new organisational knowledge comes into being by considering the context of complexity as an environment that demands innovation while at the same time being the catalyst for knowledge creation. The debate on the nature of organizational knowledge is revisited and contrasted from individual knowledge. A review of the mainstream theories of organisational knowledge creation led up to Boisot's Social Learning Cycle as the benchmark theory that is used in the rest of the argument.

Thereafter the work of Weick on Organisational Sensemaking is discussed. It is argued that the condition of complexity leads to an increase in occasions that activate and heighten organizational sensemaking processes. Parallels are noted between the process of sensemaking and parts of the Social Learning Cycle. It is shown that under conditions of comlexity, organisational knowledge creation processes and sensemaking processes are not only similar, but that organisational sensemaking can be seen as the mechanism whereby new organisational knowledge is created when organisations operate at the edge of chaos.

This has a number of implications. The theory of organisational sensemaking is applied to an area of organisational life where it has not been seen as applicable, organisational knowledge creation processes are shown to be much more fundamental phenomena than the literature suggests, and combining Boisot and Weick leads to greater theoretical elegance.

Opsomming

Organisasies bevind hulself in ‘n wêreld wat teen ‘n versnellende pas verander. Toenemend moet organisasies funksioneer in wat bekend staan as die rand van chaos—daardie area wat paradoksaal tot verlamming en ramp of tot kreatiwiteit en innovasie kan lei. In hierdie onseker omgewing word organisasies teruggewerp op hulle vermoë om nuwe organisatoriese kennis te skep. Dit is egter onduidelik hoe nuwe kennis onder hierdie omstandighede tot stand kom en wat presies sal tel as nuwe organisatoriese kennis

Die tesis probeer die prosesse waardeur nuwe organisatoriese kennis tot stand kom toelig deur die konteks van kompleksiteit te ondersoek as ‘n omgewing wat tegelyk innovasie eis en die katalis vir kennis-skepping is. Die debat oor die aard van organisatoriese kennis en hoe dit onderskei word van individuele kennis word weer aangeroer. ‘n Oorsig van die hoofstroom teorieë van organisatoriese kennis-skepping lei tot Boisot se “Social Learning Cycle” wat as die basisteorie gebruik word in die res van die argument.

Daarna word Weick se werk oor Organisatoriese Singewing bespreek. Dit word geargumenteer dat die kondisie van kompleksiteit tot ‘n toename in die geleenthede wat organisasatoriese singewingsprosesse aktiveer en verskerp lei. Parallelle tussen die proses van singewing en dele van die “Social Learning Cycle” word getrek. Daar word gedemonstreer dat onder kondisies van kompleksiteit is organisatoriese kennis-skepping– en organisatoriese singewingsprosesse nie net soortgelyk nie, maar dat organisatoriese singewing gesien kan word as die meganisme waardeur nuwe organisatoriese kennis geskep word wanneer organisasies op die rand van chaos moet funksioneer.

Die argument het ‘n paar implikasies. Die teorie van organisatoriese singewing word toegepas op ‘n area van organisasie-lewe waar dit nog nie voorheen as toepaslik beskou is nie, daar word gewys dat organisatoriese kennis-skeppingsprosesse meer fundamentele fenomene is as wat daardie literatuur suggereer, en die lees van Boisot deur die bril van Weick lei tot groter teoretiese elegansie.

Acknowledgements

This thesis is dedicated to my parents, my wife Maryna, and Amanda, Karin, Roché and Wanya, each continually inspiring me in a unique way.

Contents

Chapter 1
Introduction: How does "Aha!" become useful to an Organisation?

1.1 Towards a more generic view of organisational knowledge creation

Tsoukas[1] points out that any enquiry into organisational epistemology would be concerned with a multitude of questions about knowledge, individuals and social practices in organisations. In this particular study only one such question is addressed, namely how new organisational knowledge is created under conditions characterised by complexity. The most widely influential views of knowledge creation in organisations follow the approach of Nonaka and Takeuchi[2] which became popular in the mid 1990s. This mainstream approach to organisational knowledge creation has its roots in product development processes and this is a limitation when considering knowledge creation activities in non-manufacturing environments. Nonaka and Takeuchi's account specifically has been shown to be problematic by many other writers. It could be argued that Nonaka and Takeuchi's approach concentrates on appropriating existing individual knowledge for organisational purposes but that no explanation is offered for creativity and innovation. They also fail to offer any satisfactory explanation of the concept of organisational (as opposed to individual) knowledge. It has been shown by others that their interpretation of tacit knowledge as knowledge capable of conversion into explicit knowledge is flawed[3]. Many of these problems may be circumvented with a cognitive approach (such as sensemaking) to the creation of new knowledge. This is especially true as suggestions that organisations are increasingly dependent on knowledge abound in the literature[4] and it is therefore progressively more critical to develop an understanding of how knowledge is created in organisations.

1.2 The problem

In the fast paced and ever-changing society that exists today it has become normal for organisations to operate in an uncertain environment. Confusing signals from the

[1] Tsoukas, H. 2005, 3.

[2] Nonaka I, Takeuchi, H. 1995.

[3] Tsoukas, H. 2005, 99, 158; Cook, SD and Brown, JS. 1999.

[4] e.g. Nonaka I, Takeuchi, H. 1995; Drucker, P. 1991.

environment combined with the fact that organisations are themselves complex adaptive systems[5] made up of individuals who are themselves complex adaptive systems and interacting with yet more organisations and individuals in an almost chaotic organisational eco-system, it becomes quite clear that organisations operate in an extremely complex environment and understandably at times might even cross the border between complexity and chaos. In order to survive, be sustainable and achieve competitive advantage in such conditions, organisations are forced to continuously adapt. Innovation and creativity become organisational necessities. The latter qualities imply the creation and effective application of new organisational knowledge. The obvious question then becomes: how does an organisation operating in a complex environment create new organisational knowledge? Put differently, how is an individual organisational member's "Aha!" moment of insight transformed into useful organisational knowledge? The argument presented here quite simply asserts that sensemaking under conditions of complexity is the process whereby new organisational knowledge is generated. Under conditions of complexity, problems are not solved by working methodically, but rather with sudden creative insight.[6]

Weick[7] describes how sensemaking becomes activated under conditions of ambiguity, interruption and arousal - conditions typically experienced in and by organisations in complex situations at the edge of chaos. If sensemaking is seen as the insight that new knowledge brings, then Weick's notion of organisational sensemaking may offer an explanation for the process whereby new organisational knowledge is created by organisations operating under the complex conditions at the edge of chaos.

The research question being pondered in this study is thus:

Can sensemaking theory explain the creation of organisational knowledge in a complex environment at the edge of chaos?

In order to shed light on a possible answer, it is necessary to enquire into theories of organisational knowledge creation, complexity and sensemaking and then to show

[5] Gell-Mann, M. 1994, 297-298.

[6] Kounios et al reported a distinct pattern of brain activity in people who tend to solve problems with sudden creative insight compared to people who tend to solve problems more methodically (Kounios et al. 2008). Creative solvers exhibit greater activity in regions of the right hemisphere (associated with creativeness) and brain wave activity is such that it allows them to broadly sample the environment (instead of narrowly focusing) for experiences that can trigger remote associations to produce sudden insights.

[7] Weick, K. 1995.

commonality, which, if any logical causality is found, should lead to validating the following hypothesis:

At the edge of chaos, organisational knowledge creation is organisational sensemaking.

The hypothesis holds that organisational knowledge creation at the edge of chaos is not something that follows sensemaking, but that the sensemaking process is the very process of knowledge creation.

Normally sensemaking theory is seen as something analogous (but slightly different) to interpretation, attribution, or understanding—in short the social processes whereby organisations come to grips with events. Knowledge creation is seen as something that happens after the sense is made.[8] The argument to be made here is that in certain situations it is in fact the same process.

1.3 Foundation

Many distinguished scholars have developed philosophies, theories and models upon which the argument of this study is built. Foremost among them are:

- Karl Weick, Rensis Likert College Professor of Organizational Behaviour and Psychology at Michigan University and author of numerous books and articles;
- Murray Gell-Mann, Robert Andrews Millikan Professor of Theoretical Physics Emeritus at the California Institute of Technology, 1969 Nobel prizewinner for his work in physics, author and Distinguished Fellow of the Santa Fe Institute.
- Max Boisot, Professor of Strategic Management at the Birmingham Business School (BBS), the University of Birmingham, and Associate Fellow at Templeton College, University of Oxford. He is also a research fellow at the Sol Snider Centre, the Wharton School, the University of Pennsylvania and Associate of Centre for International Business and Management at the Judge Institute of Management Studies at the University of Cambridge.
- Haridimos Tsoukas, the George D. Mavros Research Professor of Organisation and Management at ALBA in Greece, Professor of Organisation Studies, University of Warwick and Editor-in-Chief of Organization Studies.

[8] See for instance Choo, C. 1998.

For outlining knowledge, the notions of certain philosophers, scientists and modern business theorists are examined, starting with Plato's concept of knowledge as *true justified belief*, Gettier's refutation thereof and Polanyi's introduction of the concepts of *tacit* and *explicit* knowledge. It is also necessary to introduce differences between *data*, *information* and *knowledge* and the views presented here rely strongly on the work of Max Boisot. As the study intends to stay within the borders of the organisational context, the delineation of the knowledge concept leans towards that of Ronald Maier who sees *knowledge* from a Knowledge Management perspective.

The discussion of *organisation* has its foundations in the works of modern management scientists, particularly drawing on the works of Karl Weick, Gareth Morgan, Bob de Wit and Ron Meyer, Peter Drucker and others. This leads to a practical and usable definition of what an organisation is.

Several sources have been used to get to grips with the difference between *individual* and *organisational* knowledge, the most important of which are Karl Weick, Haridimos Tsoukas and Daniel Kim.

There are a number of theories on organisational knowledge *creation*. The major ones investigated here are those by Ikujiro Nonaka, Scott Cook and John Seely Brown, Joseph Firestone and Mark McElroy, and finally, Max Boisot. Although Boisot's Social Learning Cycle is a comprehensive model encompassing more than only the creation of knowledge in organisations, it is used here to underline the link between organisational knowledge creation and complexity.

The chapter on complexity theory is broadly based on the writings of Murray Gell-Mann and work edited and written by Eve Mitleton-Kelly and attempts to summarise the theories sufficiently for a basic understanding, specifically of complexity as an enabler for knowledge creation.

The chapter on sensemaking naturally reflects the work of Karl Weick, who is widely considered to be the main author in this area.

1.4 Beyond the Horizon

This study is conceptual and explores ideas about knowledge creation in organisations under complex circumstances and is bounded by a horizon that does not include the application of such knowledge. The study is not focussed on innovation in general, learning or memory, and

only picks up on these themes where relevant to the main argument. It is not intended to clarify questions about the ontologies of chaos and complexity theory and it only describes the field of complexity science with the purpose of shedding light on knowledge creation processes. Empirical work to validate the claim that sensemaking processes and knowledge creation are similar fall outside the scope of this thesis.

1.5 The path ahead

In order to follow the logical path from the research question leading to the hypothesis, vital topics will be covered as adumbrated[9] below.

Chapter 2 will explore various views of the nature of knowledge and the creation thereof and attempt to settle on a single working definition to be used in the arguments following later. Similarly a concept of *organisation* will be outlined and thereafter a working distinction of the differences between personal and organisational knowledge will be developed.

Chapter 3 investigates those aspects of complexity theory that are relevant to the process of organisational knowledge creation.

Chapter 4 delves into the theory of organisational sensemaking and how it is related to knowledge creation.

Chapter 5 brings together the threads of the preceding chapters, culminating in support of the hypothesis that organisational knowledge creation at the edge of chaos *is* organisational sensemaking. On the basis of that conclusion, Boisot's Social Learning Cycle is reinterpreted against the background of complexity and through the lens of organisational sensemaking.

The metaphor of emergence under complexity can also be applied to the argument presented here: many small nuggets of information are presented, all of which is richly interlinked, resulting in a whole that may appear despairingly complex, even chaotic in places, but the central argument hopefully emerging from this whole as a higher level of order.

This, then, is the embarkation point at the start of a journey along a path being *constructed* as the expedition of discovery progresses to its destination. After each section we will reach a waypoint along this journey, that in the end will lead to the final synthesis as destination.

[9] Used here in the sense of partial disclosure.

Chapter 2

Organisational Knowledge Creation

2.1 The general idea

This chapter attempts to settle on a plausible definition of organisational knowledge creation that is anchored in solid theoretical foundations. It will be argued that Nonaka's knowledge creation spiral and Boisot's social learning cycle (SLC) can be seen as different interpretations of the same process. The difference is however that Nonaka's theory is about knowledge sharing rather than knowledge creation. Boisot's SLC provides a different and, for the purposes of this argument, a more usable view of knowledge creation in domains where complexity reigns and will be used as archetype for organisational knowledge creation. This chapter will proceed to demarcate the concepts of *knowledge* and *organisation*, draw distinctions between *personal* and *organisational knowledge* and then move on to theories on how organisational knowledge is created.

2.2 The Knowledge Concept

Although the concept of knowledge has been debated by the world's greatest minds, there is no definite consensus as to its exact nature and many alternate views exist, often defining knowledge in terms of equally vague concepts. It is not intended to give a comprehensive overview of the various positions in literature, but only to discuss a few conceptualisations in order to create a working definition of knowledge that will serve as a convenient notion for the remainder of this enquiry.

2.2.1 It started with the philosophers

Epistemology, the study of the nature, limitations and validity of knowledge, has elicited the attention of philosophers since times immemorial. The central question of epistemology is: "what is knowledge". Western philosophers followed the concept introduced by Plato which attempted to relate the notions of truth, belief and justification to that of knowledge, culminating in general agreement that knowledge is *justified true belief*. This means that knowledge possessed by an individual must be true, the individual must believe that it is true and there must be justification (evidence) proving the truthfulness of the knowledge. This

also implies that an increase in knowledge adds to what is believed[10] or leads to the revision of previously held beliefs.

In 1963 Gettier[11] shattered the philosophical consensus that knowledge is justified true belief by presenting counterexamples[12]. The general response to Gettier's paper was agreement that a fourth condition must be added to the knowledge definition. The search for such a condition has become known as *the Gettier problem* and has to date not been solved[13]. Although built on the equally difficult to define concepts of *justified*, *true* and *belief*, this notion of knowledge still seems to be widely supported in literature. Knowledge seen in this way is a construction representing reality rather than something that is true in an objective and universal way.[14]

Nonaka and Takeuchi[15] introduce an interesting twist to the above, arguing that knowledge is a dynamic human process of justifying personal belief toward the truth. This view is interesting as it (i) does not see knowledge as static, but rather as a process; (ii) de-emphasises the truth component; and (iii) reminds strongly of the sensemaking process whereby a plausible reality is accomplished retrospectively[16].

Many philosophical schools of thought on knowledge appeared since the 19th century of which some of the more prominent are listed below.[17] *Positivism* argued that knowledge is

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[10] Thagard, P. 1991. 101.

[11] Gettier, E. 1963.

[12] One of Gettier's counterexamples is as follows: "Suppose that Smith and Jones have applied for a certain job. And suppose that Smith has strong evidence for the following conjunctive proposition: (a) Jones is the man who will get the job, and Jones has ten coins in his pocket. Smith's evidence for (a) might be that the president of the company assured him that Jones would in the end be selected, and that he, Smith, had counted the coins in Jones's pocket ten minutes ago. Proposition (b) entails: The man who will get the job has ten coins in his pocket. Let us suppose that Smith sees the entailment from (a) to (b), and accepts (b) on the grounds of (a), for which he has strong evidence. In this case, Smith is clearly justified in believing that (b) is true. But imagine, further, that unknown to Smith, he himself, not Jones, will get the job. And, also, unknown to Smith, he himself has ten coins in his pocket. Proposition (b) is then true, though proposition (a), from which Smith inferred (b), is false. In our example, then, all of the following are true: (*i*) (b) is true, (*ii*) Smith believes that (b) is true, and (*iii*) Smith is justified in believing that (b) is true. But it is equally clear that Smith does not *know* that (b) is true; for (b) is true in virtue of the number of coins in Smith's pocket, while Smith does not know how many coins are in Smith's pocket, and bases his belief in (b) on a count of the coins in Jones's pocket, whom he falsely believes to be the man who will get the job."

[13] One example of a possible solution is that offered by Fred Dretske in *Knowledge and flow of information* where he redefines knowledge as *information based belief*. His arguments are convincingly shown to be inconclusive by William Edward Morris in *Knowledge and the Regularity Theory of Information*.

[14] Popadiuk, S, Choo, C. 2006. 307.

[15] Nonaka, I, Takeuchi H. 1995. 58.

[16] Weick, K. 1995.

[17] Maier, R. 2004. 58-59.

gained from the observation of objective reality and is the basis of natural and management science. *Constructivism* claimed that knowledge is constructed in our minds and that threfore there is no objective reality. *Critical Rationalism* held that knowledge is tentative and must be open to empirical falsification. *Empiricism* is based on the assumption that knowledge can be created only from experience. *Sociology of Knowledge* viewed knowledge as socially constructed. *Pragmatism* developed from the realisation that no practice ever engages more than a fraction of the universe and therefore knowledge represents local reality and not universal truth.

Many taxonomies of knowledge have been proposed. Much of the latest debate surrounding the knowledge construct leans heavily on Polanyi's[18] distinction between tacit knowing and explicit knowledge. Explicit knowledge refers to that which is codifiable and can be transmitted to others, while the tacit dimension, often described as *knowing*, refers to personal, subjective and intuitive knowledge which is ineffable and acquired through experience and person-to-person interaction.[19] Some scholars, such as Nonaka and Takeuchi[20], and Cook and Brown[21] see tacit and explicit knowledge as two separate categories of knowledge, while others take the position that these are but the two poles of a continuum. The category view is widespread in current literature[22] and holds that tacit knowledge is highly idiosyncratic knowledge in the human brain and cannot be separated from people who possess it, while explicit knowledge can be codified, documented and transmitted.[23] Other scholars hold the view that all knowledge have both tacit and explicit components[24] and that tacit and explicit simply illustrate the poles of a knowledge spectrum. Tsoukas[25] observes that "tacit and explicit knowledge are mutually constituted" and are inseparable. Tacit knowledge "is the necessary component of all knowledge".

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[18] Polanyi, M. 1966.

[19] The tacit/explicit distinction is reminiscent of the distinction in psychology between fluid and crystallised intelligence as postulated by Cattell in 1987. Fluid intelligence is an ability to find meaning in confusion and solve problems independent of acquired knowledge, while crystallised intelligence is the ability to apply previously acquired knowledge and skills.

[20] Nonaka, I, Takeuchi H. 1995.

[21] Cook, S, Brown, J. 1999.399.

[22] Nonaka, I. 1994; Leonard, D, Sensiper, S. 1998; Bolisano, E, Scarso, E. 2000; Roberts, J. 2000.

[23] Jasimuddin, S et al. 2005.

[24] Boiral, O. 2002; Hall, R, Andriani, P. 2003.

[25] Tsoukas, H. 1996. 14.

2.2.2 Scientists refined the concept

The distinction between tacit knowledge and explicit knowledge could be likened to Ryle's[26] earlier distinction between knowledge-how (an ability) and knowledge-that (a relation between a thinker and a true proposition), two fundamentally different forms of knowledge in his view. In an extended argument, Stanley and Williamson[27] convincingly argues that contrary to the widely accepted view that knowledge-how is essentially different from knowledge-that, this is a false dichotomy. All knowing-how is knowing-that; knowledge-how is a species of knowledge-that.[28]

Organisations concentrating on making knowledge explicit makes it usable and retainable, but at the same time vulnerable to illegal exploitation by others. Focussing on the exploitation of its members' tacit knowledge on the other hand would make it less likely to be copied by others, but more likely to be lost as a result of members leaving.[29]

Nonaka and Takeuchi hold the view that the West emphasises explicit knowledge while the Japanese has come to appreciate the value of tacit knowledge[30], giving Japanese companies an advantage in creativity and innovation. This view is confirmed by McAdam et al[31] arguing that "until recently tacit knowledge has been overlooked or toned down in relation to organizational competitiveness …".

The meaning of knowledge has changed drastically in modern times[32] from the "classical Greek view that knowledge was primarily self-knowledge and the search for a virtuous life", emphasising the ability to function effectively in a larger collective and shifting individual cognitive ability into secondary position. Codification of knowledge became possible, giving rise to the concept of information. As Tsoukas puts it: "In late modern societies 'information' denotes a set of abstract, value-free, decontextualised items, subject to human manipulation, allegedly representing the world as it is."[33] The appearance of an information concept alongside knowledge has led to massive confusion regarding the meaning of and relationship

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[26] Ryle, G. 1971.

[27] Stanley, J, Williamson, T. 2001.

[28] This raises the question whether their argument could be extended to lend support to a side of the debate whether tacit/explicit is a continuum or discrete. Is explicit knowledge a species of tacit knowledge?

[29] Jasimuddin, S et al. 2005. 107.

[30] Nonaka, I, Takeuchi, H. 1995, 8-11.

[31] McAdam, R et al. 2007. 44.

[32] Tsoukas, H. 2005. 31.

[33] Tsoukas, H. 2005. 32.

between the two notions. Drucker sees knowledge as information effective in action[34], a view echoed by Nonaka and Takeuchi: "Information is a flow of messages, while knowledge is created by that very flow of information, anchored in the beliefs and commitment of its holder. This understanding emphasizes that *knowledge is essentially related to human action*."[35] (Emphasis in the original).

Sanchez et al[36] sees knowledge as a set of beliefs held by an individual about causal relationships among phenomena. Knowledge does not imply a mental reflection of that which is "real", but rather a personal construct in order to deal with the world. "If men define situations as real, they are real in their consequences".[37]

Porter-Liebeskind[38] defines knowledge as information whose validity has been established through tests of proof. Davenport and Prusak[39] views knowledge as "a flux mix of framed experiences, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers." A similar view incorporating information into the knowledge concept is that of Firestone and McElroy[40] who see knowledge as a tested, evaluated and surviving structure of information (e.g. DNA instructions, synaptic structures, beliefs or claims) that may help the living system that developed it to adapt. None of these definitions offer any insight to clarify any possible distinction between information and knowledge.

A number of scholars make distinctions between data, information and knowledge.[41] Boisot,[42] being one of them, sees data as originating in discernable differences in physical states-of-the-world, describable in terms of space, time and energy. Stimuli that pass an agent's perceptual filters become noticed as data. Information is significant regularities in the data extracted by conceptual filters (which presupposes prior knowledge) and knowledge is a set of expectations held by agents and modified by the arrival of information. The expectations constitute prior learning. He states that "the utility of data resides in the fact that

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[34] Drucker, P. 1993. 42.

[35] Nonaka, I, Takeuchi, H. 1995. 58-59.

[36] Sanchez et al. 1996. 9.

[37] Thomas, W. 1928. 572.

[38] Porter-Liebeskind, J. 1966.

[39] Davenport, T, Prusak, L. 1998. 5.

[40] Firestone, J, McElroy, M. 2005. 198.

[41] Some also distinguish insight and wisdom (for example Davenport, T, Prusak, L. 1998), but this is not necessary for the purposes of this argument.

[42] Boisot, M, Canals, A. 2004.

it can carry information about the physical world; that of information that it can modify an expectation or a state of knowledge; finally that of knowledge in the fact that it allows an agent to act in adaptive ways in and upon the physical world."

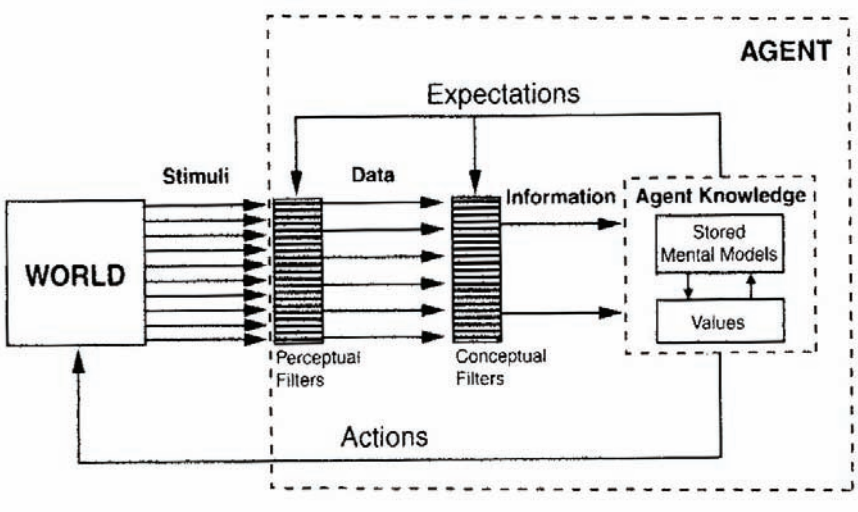

Figure 1, from Boisot, M. 2004.

In his analysis of knowledge transfer, Maier[43] reflects a view similar to that of Boisot and states that "*only data can be transported or communicated* which in turn is interpreted by individuals or social systems" (emphasis in the original). Note the similarities between Maier's and Boisot's views: sensors and perceptual filters; (re-)construction and conceptual filters producing information; (knowledge, attention) and (knowledge, expectations).

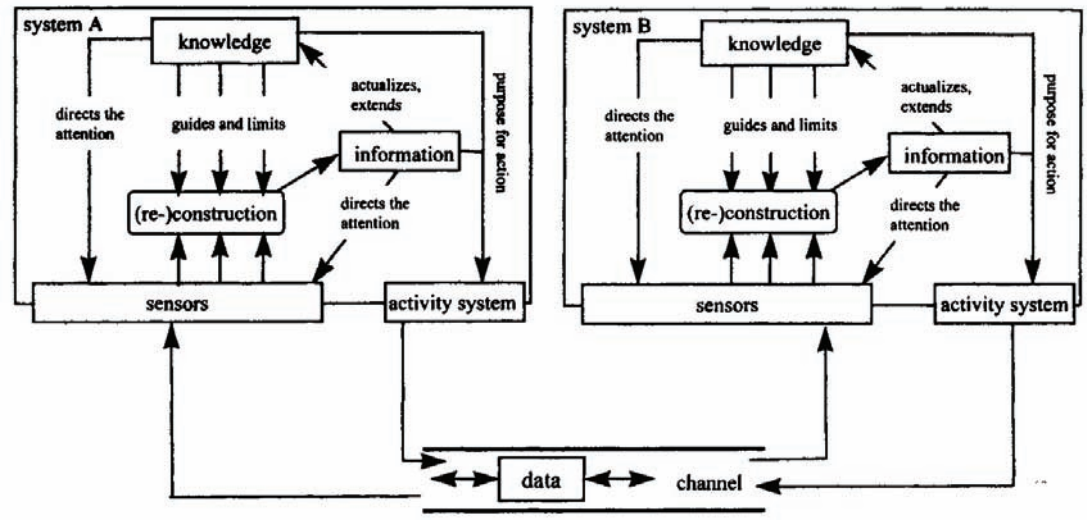

Figure 2. Transfer of information and knowledge (Maier, R. 2004. 68)

[43] Maier, R. 2004. 68.

Bell[44] defines data as an ordered sequence of given items or events, information as a context based arrangement of items showing the relationship between them, and knowledge as the judgement of the significance of events and items coming from a particular context and/or theory; and more fully as "a set of organized statements of facts or ideas, presenting a reasoned judgment or an experimental result, which is transmitted to others through some communications medium in some systematic form. Thus, I distinguish knowledge from news and entertainment".[45] Tsoukas[46] interprets Bell's underlying assumption as that of data, information and knowledge lying on a single continuum, with data requiring minimal human judgement, knowledge maximum human judgement and information somewhere in between, leading to Tsoukas' definition of knowledge as the capacity to exercise judgement based on an appreciation of context or theory or both.

Devlin[47] holds that data becomes information when prior knowledge adds meaning. Information can be codified, transmitted and exist at the level of society. Knowledge on the other hand constitutes the ability to make use of internalised information and exists solely in the individual human mind. He explains data by example: "data exists on paper and on computer disks" and sees it somewhat circularly defined as the representation of information. He views the codification of knowledge as a misnomer – codification transforms knowledge into information, enabling transmission to another temporally or geographically distant human who could acquire the information, internalise it and make it available for immediate use, thereby turning it into knowledge again.

The dichotomy between information and knowledge is underlined by Nonaka and Takeuchi[48] supporting the idea that knowledge is created out of a flow of information, "anchored in the beliefs and commitment of its holder". They, too, stress the relationship between knowledge and human action.

Blair[49] partially echoes Devlin in stating that while information can be external to a human, only a person can have and exercise knowledge. The view that knowledge is human-centered leads to an obvious question: what about other living organisms? Do animals possess

[44] Bell, D. 1999. lxi-lxiv.
[45] Bell, D. 1976. 175.
[46] Tsoukas, H. 2005. 120-121.
[47] Devlin, K. 1999. 14-15, 151-154.
[48] Nonaka, I, Takeuchi, H. 1995. 58-59.
[49] Blair, D. 2002. 1020.

knowledge? Might there be other as yet undiscovered life forms capable of having knowledge? Might computers develop into intelligent machines capable of acquiring knowledge? Barring the last, these and other related questions are outside the scope of this study, which will confine itself to human knowledge.

Prusak[50] comments that many authors make the fundamental mistake of confusing information with knowledge. While information has become available to more people than ever before due to the spread of access to the Internet, this remains quite different from knowledge. A young woman in Shanghai can gain access to instructions on how to perform a laparoscopic appendectomy, but this does not enable her to perform the operation. The knowledge to carry out such an operation only comes after years of hands-on surgical training. Prusak describes information as "a message, one-dimensional and bounded by its form: a document, an image, a speech, a genome, a recipe, a symphony score. You can package it and instantly distribute it to anyone, anywhere." He emphasises the development of knowledge from information and the tacit dimension thereof by explaining that "knowledge results from the assimilation and connecting of information through experience, most often through apprenticeship or mentoring".

Kogut and Zander[51] explains the difference between information and knowledge as follows: "Information is a factual statement, such as 'inventory consists of 100 items'. Knowledge is a recipe describing how activities are carried out, such as 'inventory is ordered when only 25 items remain'. Like many others, this view emphasises the link between knowledge and action.

An explanation for some of the confusion surrounding the concepts of data and information, and data and knowledge is offered by Miller et al's[52] proposal of a "chaining process" that takes place in organisations. Explicit knowledge at a lower organisational level might be treated as information or data by processes or people at higher organisational levels; and conversely, data or information emanating from higher organisational levels might be treated as knowledge at lower levels. Miller et al sees data as the representation of an object; information as the aggregation of data into something that has meaning for humans or

[50] Prusak, L.2006. 19.

[51] Kogut, B. and Zander, U. 2003. 520.

[52] Miller et al. 2001.

automated processes; and finally knowledge as that which is derived or inferred by assimilating information within a perceived context, experience or business rules.[53]

To hold that knowledge can exist embedded in machines or in codified form in documents is tantamount to suggesting that knowledge would exist in the absence of sentient beings. "External knowledge, if not viewed as information, represents a paradox."[54] Polanyi believes that explicit knowledge only has meaning when embedded in tacit knowledge – to imagine explication is tantamount to destroying the meaning of knowledge, no knowledge exists outside of tacit knowledge.[55] "… Knowledge as such is not stored anywhere. All that can be stored is reifications in the form of artefacts, or tools, which can only become knowledge when used in communicative interaction between people."[56]

2.2.3 Organisational theorists attempted to make it practical

In contrast to most literature reflecting a monistic knowledge landscape, Cook and Brown[57] contends that there are four distinct forms of knowledge, each one on equal standing with the other three. Each form is represented as a cell in a two dimensional matrix of which one dimension distinguishes between tacit and explicit knowledge and the other between individual and group knowledge. They see these knowledges as that which people possess and contend that there is yet another parallel facet, namely *knowing*, which is related to action.[58] Like Nonaka and Takeuchi, Cook and Brown, although basing their understanding of the concept on Polanyi,[59] use the tacit/explicit distinction in a fashion that diverges from Polanyi's original conceptualisation which holds that all knowledge is rooted in tacit knowledge, i.e. explicit knowledge has a tacit dimension. Although stating that knowing should not be confused with tacit knowledge, their distinction seems artificial and contrived[60]. Their notion of group knowledge as a distinct knowledge category where knowledge is held by a group, as opposed to an individual, is questionable. It will be argued later that a group of people (an organisation) constitutes a complex system where knowledge is held by the individuals in that group, but because of the multiple linkages and interactions

[53] Miller et al. 2001. 365.

[54] Johnson, W. 2007. 128.

[55] Polanyi, M. 1966.

[56] Stacey, R. 2000. 23.

[57] Cook, S, Brown, J. 1999. 382.

[58] Cook and Brown coined the phrases *epistemology of possession* and *epistemology of practice* to describe these.

[59] Cook, S, Brown, J. 1999. 384.

[60] Cook, S, Brown, J. 1999. 388.

between individuals, behaviour could *emerge* which could constitute conduct reflecting something greater than the sum of the knowledge of the individuals in the group. This superior knowledge is mistakenly seen as group knowledge.

A number of researchers propose different types and classifications of knowledge. Zack[61] (and others) typifies knowledge as procedural (know-how), causal (know-why), conditional (know-when) and relational (know-with). Porter[62] classifies knowledge according to its usefulness to the organisation, referring to knowledge about customers, products, processes and competitors. Others isolate dichotomies such as local vs. universal, codified vs. uncodified, procedural vs. declarative. It could be argued that such classifications are not in themselves helpful insights into the nature of knowledge, but only refer to specific knowledge domains, conflating the *concept* of knowledge with the *content* of knowledge. Popadiuk and Choo[63] confuse the issue even further by introducing cultural knowledge as a distinct knowledge category and not as a domain.

Instead of arriving at a universal philosophical definition Maier[64] takes a pragmatic approach and provides a delineation of knowledge specifically as it suits his discussion of knowledge management systems:

"Knowledge comprises all cognitive expectancies – observations that have been meaningfully organized, accumulated and embedded in a context through experience, communication, or inference – that an individual or organizational actor uses to interpret situations and to generate activities, behaviour and solutions no matter whether these expectancies are rational or used intentionally. … In a nutshell, knowledge can be defined as the capacity to interpret and act."

"Learning is experience. Everything else is just information" is a quote widely attributed to Albert Einstein, indicating Einstein's view that knowledge is personal and that there is a split between information and knowledge.

Johnson[65] proposes what he calls a pattern-recognition synthesis model to explain the mechanisms and process of developing tacit knowing. Tacit knowing is built from within and takes place via patterns in data or information that may be described with varying degrees of

[61] Zack, M. 1998.
[62] Porter, M. 1985.
[63] Popadiuk, S, Choo, C. 2006. 307.
[64] Maier, R. 2004. 73.
[65] Johnson, W. 2007.128-132.

explicitness. These patterns may be perceived subconsciously but are all scrutinised by the brain which determines which patterns to focus on and thus determines perception.[66] Perceived patterns in data or information are then processed and synthesized into new ideas, i.e. new knowledge. One of the major premises of this model is that all knowledge exists within the heads of individuals and that all external "knowledge" is best treated as information.

Rooney and Schneider[67] list observations they have made about knowledge, which include the following:

(i) Knowing is bound to human consciousness. Storage media contain data, texts and images but not knowledge.

(ii) Knowing is a social and cultural process and is therefore sensitive to social and cultural conditions.

(iii) Because knowledge is sensitive to context and is fallibly enacted, it cannot be managed. Data can be managed but context and human fallibility can only be influenced.

(iv) Knowledge is an emergent process that is heavily reliant on tacit or unconscious processes working co-dependently with explicit knowledge, leading to fallible enactment with unpredictable and enigmatic results that cannot always be easily controlled, predicted, documented, transferred or transmitted.

(v) Fallibility and the enigmatic mental processes are the wellsprings of innovation and creativity.

(vi) Tacit and explicit dimensions of knowledge are not dichotomous but interact with each other.

(vii) The act of imposing order on messy knowledge systems is a political act and should be monitored for the inappropriate use of power and how it restricts knowledge and its enactment.

The set of observations above is particularly relevant to studies of knowledge in the organisational context as it addresses the human, social, cultural and political dimensions, all of which partly defines organisational life. Observation (iv) in addition provides a link

[66] There is some similarity between Johnson's pattern-recognition, Boisot's perceptual filters and Maier's filters.

[67] Rooney, D, Schneider, U. 2005. 33.

between knowledge creation and complexity as well as sensemaking. This will become clear in later chapters.

2.2.4 Knowledge distilled

Conspicuous commonalities among the conceptualisations of knowledge presented above include the following:

i. Knowledge resides in the human brain and does not exist external to it (Nonaka and Takeuchi, Sanchez, Davenport and Prusak, Maier, Devlin, Blair, Johnson, Einstein, Rooney and Schneider);

ii. Knowledge results in human action (Drucker, Nonaka, Boisot, Maier);

iii. Knowledge is separate from and develops from information (Tsoukas, Drucker, Nonaka, Porter-Liebeskind, Boisot, Bell, Devlin, Blair, Johnson);

iv. Knowledge is a framework/belief/expectation (Sanchez, Nonaka, Boisot, Maier, Plato).

This study does not offer any new insight into the primary epistemological question and will not offer a sempiternal explanation, but pragmatically needs a working definition of the knowledge concept in order to delineate the concept and define what is meant by it in the following paragraphs and chapters. The definition should reflect the commonalities identified above and allow various classifications. It should be flexible enough to not exclude most of conceptualisations of knowledge discussed above. A definition closely aligned to that of Maier is offered:

Knowledge is the expectations, modifiable by perceived information, residing in the human brain, allowing plausible interpretations of the environment and used in determining appropriate action.

By using human *expectation*, which may be conscious or subconscious, the definition allows for the explicit and tacit dimension. It implies both social context and history. It does not preclude the classifications proposed by a multitude of scholars. It encompasses examples of knowledge like scientific findings, theories, heuristics, rules of thumb, techniques, experiences, opinions, cultural customs, norms and world views[68] and has the generality to not exclude the view that all knowledge is social, situated and contextual.[69] It is even possible

[68] Maier, R. 2004. 73.

[69] Jashapara, A. 2007. 755.

to accommodate the concept of self-transcending knowledge,[70] which is the ability to sense potential, in the conceptualisation as stated. The definition does not imply that the human brain is not capable of containing information and data in addition to knowledge. It does not exclude the notion that knowledge may bear no resemblance to reality, facts or objective truth (the discussion of which is outside the scope of this study) and may persist as maladaptive schemata.[71]

2.3 What is an Organisation?

With a working definition of *knowledge*, we also need a similar working definition of *organisation*[72] before attempting to demarcate the concept of *organisational knowledge*.

Weick[73] uses an ontology of sensemaking, as proposed by Wiley, to position the concept of organisation. There are three levels of sensemaking above the individual level: (i) intersubjective where "the self gets transformed from 'I' into 'we'"; (ii) generic subjectivity where individuality disappears and social structure emerges; and (iii) the extrasubjective which operates on the cultural level. Weick sees organisations as linking the intersubjective and the generically subjective and supports this by quoting Smircich and Stubbard:[74] organization "is a set of people who share many beliefs, values and assumptions that encourage them to make mutually-reinforcing interpretations of their own acts and the acts of others".

Westley[75] proffers a definition that does not require many prerequisites before a group of people could qualify as an organisation, describing organisation as "a series of interlocking routines, habituated action patterns that bring the same people together around the same activities in the same time and places". A similar unpretentious description is that of Drucker: "an organization is a human group, composed of specialists working together on a common task", adding that the function of organisation is to make knowledge productive.[76] Westley's

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[70] Scharmer, C. 2001. 68-69.

[71] Gell-Mann, M. 1994. 291-305.

[72] Thorngate's (Thorngate, W. 1976) postulate of commensurate complexity states that theories of social behaviour can only satisfy two of the three criteria of generality, simplicity and accuracy. Organisations are tremendously complex systems and attempting an overly accurate definition may prove to be impossible. The definition developed thus trades accuracy for simplicity and generality.

[73] Weick, K. 1995. 70-71.

[74] Smircich, L, Stubbard, C. 1985. 727.

[75] Westley, F. 1990. 339.

[76] Drucker, P. 1993. 48-49.

constraint of "people together in the same time and places" is somewhat odd in the Internet age. Lee and Cole's[77] study of knowledge creation in a community of open-source software developers shows clearly that a virtual community, separated across both geographic and temporal dimensions, could also be seen as an organisation. Westley's definition could be improved by substituting "timeless time and the space of flows" for "the same time and place", timeless time and the space of flows being Castells' concepts of a virtual space where people are united, not necessarily in real time, by flows (of information, work, interests) across space and time. [78]

Organisation is a tool for accomplishing more than that which individuals can singly achieve. "Collective structures form when self-sufficiency proves problematic."[79] People commit to interacting relationships in order to realise a personal goal which they cannot get done by themselves. That is the start of an organisation. Shared goals only emerge later when individuals search for justifications of their earlier interdependent actions to which they have become bound.

What is described as a technical definition is offered by Laudon and Laudon[80]: "An organization is a stable, formal social structure that takes resources from the environment and processes them to produce outputs". This definition is complemented by a more behavioural conceptualisation: "… it is a collection of rights, privileges, obligations and responsibilities that is delicately balanced over a period of time through conflict and conflict resolution".

Exactly what an organisations are is difficult to pin down as they lend themselves to multiple conflicting interpretations, all of which are plausible.[81] In line with this notion and instead of developing a definition of the organisation concept, Morgan[82] uses a series of metaphors to accentuate aspects of organisation. Organisation is respectively presented as:

- Machines, highlighting bureaucratic organisational structures made of interlocking parts, each playing a clearly defined role in the functioning of the whole;
- Organisms, stressing organisational needs and the interrelationship between organisation and environment;

[77] Lee, G, Cole, E. 2003.
[78] Castells, M. 2000. 407-499.
[79] Weick, K. 2001. 17.
[80] Laudon, K, Laudon, J. 2006. 73.
[81] Daft, R, MacIntosh, N. 1981.
[82] Morgan, G. 1997.

- Brains, emphasising the importance of information processing and learning;
- Cultures, drawing attention to values, ideas, beliefs, norms, rituals and other "patterns of shared meaning" that steer organisational behaviour;
- Political systems, putting conflict, power relationships and divergent interests which influence organisational activity in the spotlight;
- Psychic prisons, where organisational members become trapped by their own conscious and unconscious processes;
- Flux and transformation, by focusing on ever present change; and
- Instruments of domination, accentuating the potential that exists in organisations to exploit not only members, but all around it.

Organisations are complex social systems populated by self-thinking human beings each with their own feelings, ideas and interests[83], i.e. organisations are *purposeful* in the sense that components of the organisation each have their own purpose which may or may not coincide with the organisational purpose[84]. The issue is further complicated by the fact that members of an organisation seldom agree on the exact purpose of the organisation. Strategic planning is frequently used as a mechanism to remedy this deficiency, attempting to align all organisational members' views on organisational purpose by defining organisational mission, vision and preparing strategic plans as a roadmap of how to get from the current situation to that which is envisaged in the organisational vision.

This view of organisation as a complex system is echoed in a useful outline offered by Checkland and Holwell[85] from a Soft Systems Methodology perspective. Their observations are interpreted by Jackson[86] as follows: Organisation "only arises because of the readiness of people, members and non-members alike, to talk and act as though they were engaging with a collective entity capable of purposeful action in its own right. On this basis, there may emerge a degree of agreement on purposes, social processes to pursue those processes and criteria for evaluating performance. This, in turn, may lead to the definition of organizational 'roles' and the establishment of norms and values. Despite the willingness of individuals to

[83] De Wit, B, Meyer, R. 2005. 207.
[84] Jackson, M. 2003. 9-10.
[85] Checkland, P, Holwell, S. 1988.
[86] Jackson, M. 2003. 185-186.

conform in this way, there will be many different conceptualizations of the nature and aims of the 'organization', premised on the values and interests of individuals and subgroups, apart from any 'official' version of its purpose."

Viewed from a sensemaking perspective, organisations can be seen as "collections of people trying to make sense of what is happening around them.".[87] The notion that an organisation is a group of people brought together to accomplish a goal is given an interesting twist by Weick[88] in stating that "organizations begin to materialize when rationales for commitment[89] become articulated. Since the decisions that stimulate justifications originate in small-scale personal acts, organizational rationales often originate in the service of self-justification. Only later does justification become redefined as collective intention." Two important points contained in this are: (i) that an organisation could begin as a small personal act, and (ii) that organisational goals could originate as the justification of that small personal act. "Through a mixture of reification, enactment, imitation and proselytizing, incipient social structure is acted into the world and imposes order on that world. This process both creates new organization and reaffirms organization already in place".[90] An individual's commitment could give rise to an organisation, its goals, and strengthen organisational structures, role systems, groups, order and elements already in place. As people in the organisation gradually get exposed to the results of the individual's commitment (which assist them to handle equivocality), their own actions become more orderly, predictable and organised. These ideas lead Weick[91] to depict organisation as "a stream of problems, solutions and people tied together by choices … that become organized to justify choices". Organisations are loosely coupled systems which might be anarchies, but *organised* anarchies[92].

Individuals in an organisation all make choices which potentially could shape the organisation and set or influence its goals. It is, however, the choices and justifications of those in power, the managers, owners, or whoever controls the reward system, that get

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[87] Weick, K. 2001. 5.

[88] Weick, K. 2001. 7.

[89] Three conditions are necessary for behavioural commitment: choice, irreversible action and public awareness of that action. Commitment is retrospectively justified.

[90] Weick, K. 2001. 15.

[91] Weick, K. 2001. 28.

[92] Weick, K. 2001, 34.

adopted and have the greatest influence on the organisation. When the current dominant coalition changes, the definition of rational conduct in the organisation also changes.[93]

The importance of knowledge as an element in organisation is emphasised by a number of authors. Spender[94] views the organisation as "a body of knowledge about the organization's circumstances, resources, causal mechanisms, objectives, attitudes, policies and so forth." Von Krogh et al[95] feel that the concept of organisation as it has been known over the preceding century is inaccurate and that organisation "can be seen as a *stream of knowledge.* (Emphasis in the original). They call for a better understanding of the organisation as a knowledge system. Kogut and Zander see firms (organisations with an economic purpose) as "social communities that serve as efficient mechanisms for the creation and transformation of knowledge into economically rewarded products and services"[96]. They also express the opinion that organisations thrive as a result of their ability to create new knowledge.[97] Grant[98] sees the firm as an organisation which creates conditions enabling multiple individuals to integrate their specialist knowledge.

The discussion above leads to the following working definition of an organisation:

An organisation is a grouping of people bound together in a collective social entity by the pursuit of an organisational goal set by those in power, characterised by shared understandings and the application of knowledge.

Stated simply like this, the definition nevertheless provides for placing the concept between the intersubjective and generically subjective and although not explicit, is general enough to at least allow interpretation which could include all the views discussed above.

2.4 Individual vs. Organisational Knowledge

Having described what is meant by *knowledge* and *organisation*, it is now necessary to investigate the concept of *organisational knowledge*, especially after having delineated *knowledge* as something that exists in the individual human brain. The intention is not to

[93] Weick, K. 2001. 35.
[94] Spender, J. 1989. 185.
[95] Von Krogh et al. 1994. 54.
[96] Kogut, B. and Zander, U. 2003. 517.
[97] Kogut, B. and Zander, U. 2003. 525.
[98] Grant, R. 1996. 112.

present a specific theory of organisational knowledge[99], but to develop a conceptualisation to be used in what follows. It is also important to note that the resource-based view of the firm[100] has drawn attention to the importance of intangible assets which are idiosyncratic to the firm and difficult to imitate, providing the firm with sustained competitive advantage. These intangible resources are largely knowledge based and include the knowledge and skills of each individual member, formal systems for organising individuals and technology and informal systems or culture.[101]

In an analysis by von Krogh et al,[102] elements of which can be found in many later studies, a notion of organisational knowledge is developed with the following properties: (i) it is shared among organisational members; (ii) it is scalable and connected to the organisation's history; and (iii) it both demands and allows for languaging[103]. It is shared in the sense that individuals' private knowledge is shared with other organisational members through speaking, gesturing, writing and other subtle social mechanisms, allowing social norms to develop to coordinate the opinions of organisational members as to what they observe. It is scalable, enabling thinking at the organisational as well as the operational levels. It is connected to the organisation's history allowing prior knowledge to influence current perception and cognition, Languaging refers to the process of developing and continually refining and redeveloping a specific organisational terminology allowing unique distinctions to be made.

Swart and Pye[104] developed a model that conceptualised organisational knowledge as *collective tacit knowledge*, meaning tacit knowledge held individually but constructed collectively as it shapes and is shaped by collective organisational action and experience. They use a metaphor of an atlas: each person in the organisation may have a map of one continent, but when "acting together" a map of the world is presented. A subject in their case study is quoted as saying: "Sometimes you have this picture, right? But you know there are holes in it. Luckily you know who to talk to, to fill those holes and you know, sometimes you

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[99] A *corporate epistemology*, as it is referred to by von Krogh, Roos and Slocum. 1994. 53.

[100] The fundamental principle of this view is that the application of the resources held by a firm leads to competitive advantage.

[101] Tsoukas, H, Mylonopoulos, N. 2003. 911.

[102] Von Krogh et al. 1994. 61.

[103] Also see Jashapara's realist theory below.

[104] Swart, J, Pye, A. 2002.

don't even want to fill them in you just need to know who could help you with them."[105] The visualization that emerges is one of an organisation made up of individuals, each holding an overlapping or unique subset of the encompassing collective organisational knowledge and with further knowledge about the sources of knowledge not held by him/her.

A similar view is expressed by Quinn et al[106]. Knowledge resides in individuals and the concept of organisational knowledge is best seen as a metaphor. Literature on organisational knowledge generally offers one of two views: (i) that organisations do not have knowledge, but that individual members of the organisations possess knowledge; and (ii) that organisational knowledge exists on a higher ontological level than simply that of the individual. Bhatt[107] argues that organisational knowledge and individual knowledge are distinct, yet interdependent. He comes to this conclusion by observing that collaboration between individuals is required where a single person does not possess the knowledge required to perform a specific task and continues to develop a framework purporting to explain the relationship between individual and organisational knowledge. The framework is a two dimensional matrix with one axis representing task complexity and the other the nature of interaction between organisational members. Although this approach offers a taxonomy based on information sharing and task complexity, it does not present a precise conceptualisation of what organisational knowledge is.

Grant[108] argues that focus on the organisation as unit of analysis runs the risk of reification and by defining rules, procedures, norms and conventions as knowledge fails to direct attention to the process where such "organisational knowledge" is created by the interaction of individuals.

In an organisational setting, which is both complex and dynamic, knowledge cannot remain static. Organisation members are continuously confronted by new information and social interaction. Information exchange and social interaction happens both internal to the organisation and also by interfacing with the organisational environment.[109] This setting is different from one where the individual is isolated and provides the ideal environment rich in ambiguity, dense with information, bountiful in social interaction and with sufficient

[105] Swart, J, Pye, A. 2002. 13.
[106] Quinn et al. 1996.
[107] Bhatt, G. 2002. 33-35.
[108] Grant, R. 1996. 113.
[109] Bhatt, G. 2000. 90.

complexity for the creation of new knowledge. In such an environment new knowledge *emerges* that would not have been possible in an isolated environment, knowledge that could be labelled *organisational knowledge.* The knowledge creation process is organisational and the knowledge might be shared by multiple organisational members, but the knowledge is still held individually, although created or acquired in an organisational setting.

The collective mind, as envisaged by Weick and Roberts[110], may shed some light on the organisational knowledge concept. A collective mind manifests in the way individuals interrelate their actions – individuals act within an envisaged social system of joint action and interrelate their actions with the envisaged joint action system. The collective mind is an emergent joint accomplishment known in its entirety to no one, although portions are known differentially to all: a distributed system.[111]

This conception of collective mind is analogous to Kay's[112] observation that organisational knowledge is more than the sum of the knowledge possessed by individuals in the organisation. It is a collective pattern formed within and drawn upon by the firm. This, however, is not sufficient to clarify the difference between individual and organisational knowledge. Kay's statement that "the purest form of organizational knowledge is where each employee knows one digit of the code which opens the safe" only underscores the fact that collaboration is necessary for task completion[113] and does not demonstrate that *organisational knowledge* is more than the sum of the knowledge residing in individual organisational members[114].

Organisational knowledge could be seen as the knowledge individual members of an organisation collectively possess, which is used, appropriated and generated by them in an organisational context. Tsoukas sees this as the "weak" conceptualisation of organisational knowledge. In a "strong" sense, knowledge become organisational when "as well as drawing distinctions in the course of their work by taking into account the contextuality of their actions, *individuals draw and act upon a corpus of generalizations in the form of generic rules, produced by the organization*".[115] The views of both Kay and Tsoukas presuppose

[110] Weick, K, Roberts, K. 1993.

[111] Tsoukas, H. 2005. 100.

[112] Kay, J. 1993. 73.

[113] Tsoukas, H, Mylonopoulos, N. 2003. 912.

[114] Also see Fagin's concept of distributed knowledge below.

[115] Tsoukas, H, Vladimirou, E. 2005. 124.

collectively shared meanings among the members of an organisation. Tsoukas and Vladirimou conclude that "… knowledge is the individual capacity to draw distinctions, within a domain of action, based on an appreciation of context or theory, or both." and "… Organizational knowledge is the capability members of an organization have developed to *draw distinctions* in the process of carrying out their work, in particular *concrete contexts*, by enacting sets of generalizations (*propositional statements*) whose application depends on historically evolved *collective understandings* and experiences."[116] Note that in both gestations knowledge is seen as a capacity to draw distinction within a context. The added elements for organisational knowledge are the key concepts *in the process of carrying out their work* and *enactment of generalisations depending on historically evolved collective understanding*. In other words organisational knowledge still resides in members of the organisation, but differs from personal knowledge in that (i) it is used in fulfilling a role in the organisation; and (ii) is applied guided by collective understanding.

In an examination of the nature of knowledge in multi-agent systems, Fagin et al[117] point out that an agent in a group must consider not only facts that are true about the world, but also the knowledge of other agents in the group. This imposes an additional burden on the members of any organisation. They discriminate between distributed knowledge and common knowledge. A group has *distributed knowledge* of the fact φ if the knowledge of φ is distributed among its members, so that by pooling their knowledge together the members of the group can deduce φ, even though it may be the case that no member of the group individually knows φ.[118] A group has *common knowledge* of the fact φ when everyone simultaneously knows the fact φ, everyone knows that everyone knows φ, everyone knows that everyone knows that everyone knows φ, and so on.[119] Common knowledge is a prerequisite for convention (red means stop, green means go), discourse understanding (placing remarks in context), achieving agreement and coordinated action.[120] This clearly implies that without common knowledge no organisation would be able to function and without using distributed knowledge no organisation would be able to exploit knowledge maximally.

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[116] Tsoukas, H, Vladimirou, E. 2005. 128.

[117] Fagin, R et al. 2003.

[118] Compare with Kay's example of employees each knowing a single digit of a safe's combination.

[119] Grant, R. 1996, offers the following on page 115: "At its most simple, common knowledge comprises those elements of knowledge common to all organization members: the intersection of their individual knowledge sets."

[120] Fagin, R et al. 1995. 2-3.

Organisation is social and so is organisational knowledge. "A well-developed organization mind, capable of reliable performance, is thoroughly social. … As people move toward individualism and fewer interconnections, organization mind is simplified and soon becomes indistinguishable from individual mind. … With more development of social skills goes more development of organization mind and heightened understanding of environments."[121] In such a social context power relations come to the fore. Organisational politics and power relationships shape "the validity criteria in terms of which competing knowledge claims are judged and has a decisive influence on the extent to which specialized bodies of knowledge across an organization are brought together to constitute *organizational* knowledge."[122] This introduces the idea that organisational knowledge might be the knowledge held individually and collectively (or Fagin et al's conceptions of common and distributed knowledge) by organisation members, which is granted validity by those in power, although it may not be the true justified belief[123] of all individuals in the organisation.

Arguing from a systems theory perspective, Seidl[124] contends that organisations are complex systems and develop knowledge in an attempt to reduce complexity. Knowledge is understood to be a structure that determines the way information is dealt with and organisational knowledge is described as decision structures, both formal (the product of earlier decisions) and those that emerge informally (organisation culture) as an unintended consequence of decision processes.[125] Note that this conception is another that invokes organisational history by implication.

The transcendental notion that organisational knowledge could be a property of an encompassing collective mind which is more than common and distributed knowledge is difficult to justify and might only become possible when science finds a way to interconnect human brains.

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[121] Weick, K, Roberts, K. 1993. 378.

[122] Tsoukas, H, Mylonopoulos, N. 2004. S4.

[123] *True justified belief* is used here to emphasise the *knowledge* concept. The definition developed previously could have been used, but that could have introduced syntactical confusion.

[124] Seidl, D. 2007. 23, 27.

[125] He points out the corollary that knowledge limits possibilities and therefore produces a nonknowledge consisting of those excluded possibilities – a dark side of knowledge. Intelligence is conceptualised as the ability to deal with nonknowledge.

Developing a realist theory of organisational knowledge, Jashapara[126] reasons that two primary aspects, namely organisational consciousness and organisational memory have been neglected in discourses on organisational knowledge. Organisational knowledge is explained as a hierarchy of organisational memory (knowledge structures), the collective consciousness (knowledge processes) and tacit and explicit knowledge[127] (knowledge behaviours). Organisational memory resides in the brains of individuals as well as in the artificial memories of information systems. Collective organisational consciousness is not "some super mind floating in the sky", but embedded in people's brains as shared mental models influenced by personal relationships, stories and the construction of meaning through language.[128] This theory begins to point to the way in which the sum of individual knowledge, through being influenced by organisational context, could be characterised as organisational knowledge.

The social context of organisational knowledge creation is also noticed in Camagni's[129] portrayal of collective learning as a process of *dynamic* and cumulative knowledge creation that has many *synergy* advantages due to its *interactive* character (emphases added).

A model that integrates individual and organisational learning was developed by Kim in the early 1990's.[130] Kim's definition of learning as "increasing one's capacity to take effective action", read together with the working definition of knowledge presented earlier, means that learning (as used by Kim) is an increase in knowledge and that his model could also shed more light on the relationship between individual and organisational knowledge.

[126] Jashapara, A. 2007.

[127] Tacit and explicit knowledge is accepted as existing along a continuum and not as two distinct entities.

[128] This idea reminds of the languaging concept proposed by von Krogh et al.

[129] Camagni, R. 1995.

[130] Kim, D. 1993.

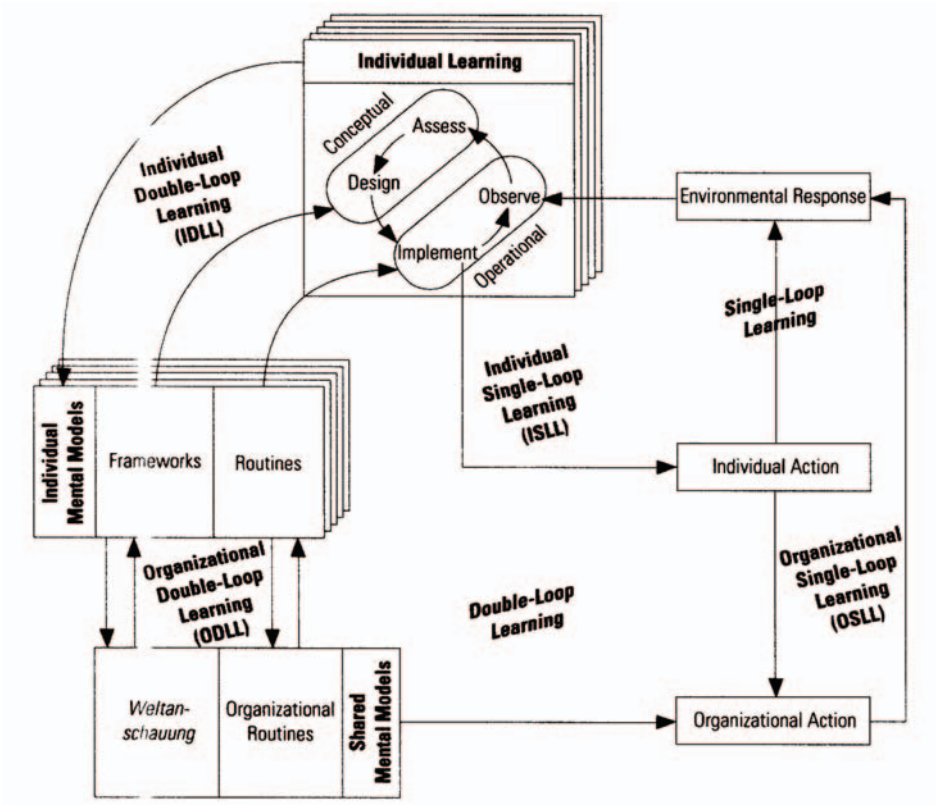


Figure 3. Integrated model of organisational learning, from Kim, D. 1993. 44

He further defines organisational learning as "increasing an organization's capacity to take effective action". He recognizes that any model of organisational learning has to resolve the dilemma of imparting intelligence and learning capabilities (i.e. the capacity to acquire and hold knowledge) to a nonhuman entity without anthropomorphising it. Kim sees the mechanism whereby individual learning is transferred to the organisation as the heart of organisational learning. This mechanism is organisational memory in the form of everything that is contained in an organisation that is somehow retrievable, like documents, electronic media as well as what is in the minds of all organisational members, including standard operating procedures and organisational culture. Individual mental frameworks become embedded in the organisation's *weltanschauung* which is a reflection of its culture, deep-rooted assumptions, artefacts and overt behaviour rules. Individual routines that are proven sound over time become standard operating procedures

The notion of organisational knowledge developed here for purposes of what follows, is:

Organisational knowledge is the aggregate of both the distributed and common knowledge held by individual members of the organisation, applied in the organisational context, the

application of which is shaped and guided by power relations and the unique idiosyncratic organisational context and history in which it is utilised.

The definition could be superimposed on a slightly modified model version of Kim's model of organisational learning to depict a model of organisational knowledge:

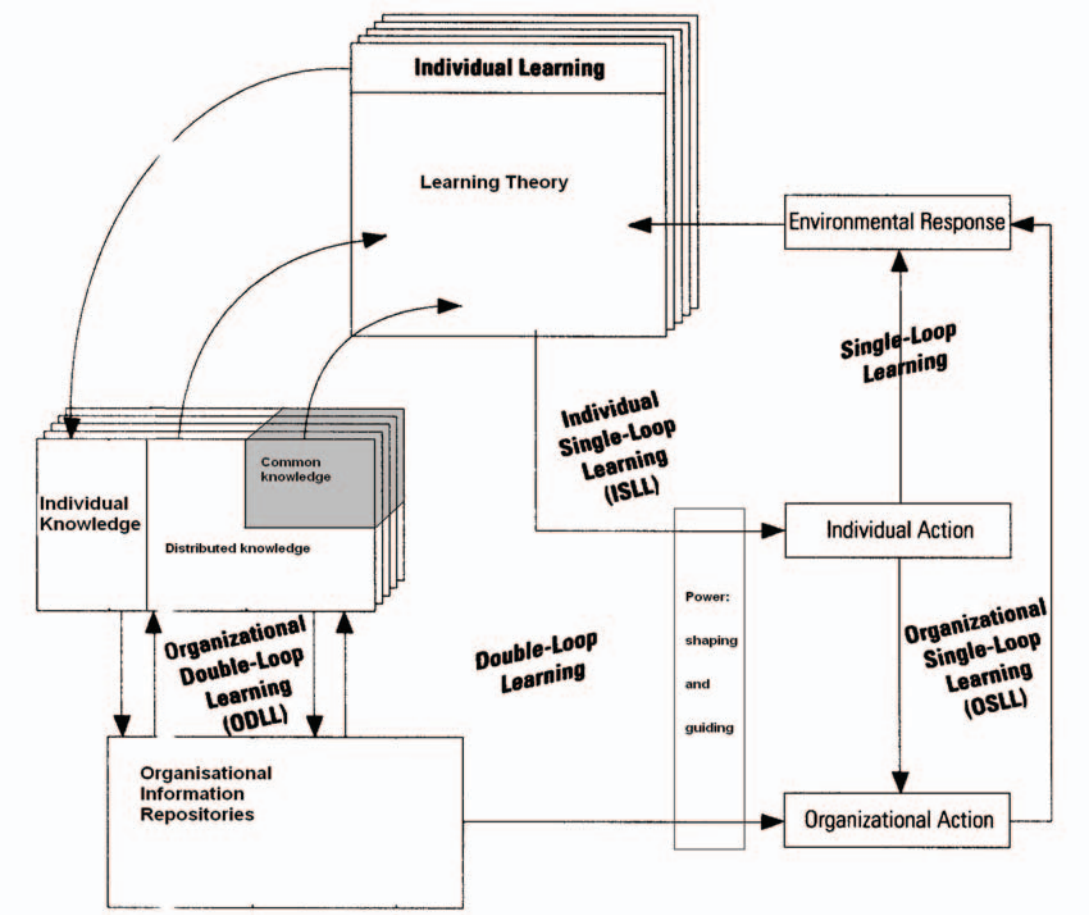


Figure 4. Model of Organisational Knowledge

This definition is consistent with the notion of knowledge residing within the human brain and that *organisational* knowledge is simply the way that knowledge is generated, applied, relegated or promoted by power relations, pooled, shared, shaped by organisational history culture, routines and terminology *in a social organisational setting*. It also implies that knowledge held by an organisation member but not used in the organisational context is not organisational knowledge. The definition also recognises the dual character of power/knowledge relations where power both acts on knowledge by producing and justifying

rationalities and interpretations, as well as through knowledge, by itself being an ongoing knowledgeable accomplishment.[131]

2.5 Organisational Knowledge Creation

Having described what is meant in the context of this study by knowledge, organisation and organisational knowledge, the process whereby organisational knowledge comes into being should now be unpacked. The mechanism in focus is the creation of new knowledge, i.e. not the appropriation of individual knowledge, which may be new to the organisation, for first-time use in the organisation, but the bringing into being of knowledge not possessed either collectively or commonly by organisational members. New knowledge gets created when our skilled performance is punctuated in new ways through social interaction.[132] The organisation offers the ideal social setting for exactly the kind of directed social interaction to create new knowledge.

Theories of organisational knowledge creation have been dominated since the early to mid 1990's by Ikujiro Nonaka's Theory which had its roots in the early 1980's when Nonaka was requested to deliver a paper at the Harvard Business School on unique features of the new product development process within Japanese companies.[133] Nonaka's ideas, first published in 1991, drew on studies of information creation in Japanese companies in the mid to late 1980's and early 1990's and culminated in his seminal work[134] (together with Hirotaka Takeuchi) in 1995. The theory was eagerly accepted in the West as an explanation for the business successes of Japanese companies while Western companies were meeting with less success and still, despite grave arguments questioning its validity, is uncritically accepted by many contemporary authors.[135]

Nonaka's "SECI knowledge generation engine" has achieved paradigmatic status[136] since its publication and will only be presented in brief as there is little value in yet another detailed description of the theory. It is however important to dwell upon problematic features of the theory and its roots. There is obvious danger in the acceptance of a flawed theory as it leads

[131] Marshall, N, Rollinson, J. 2004. S77.

[132] Tsoukas, H. 2001.

[133] Nonaka, I, Takeuchi, H. 1995. vii.

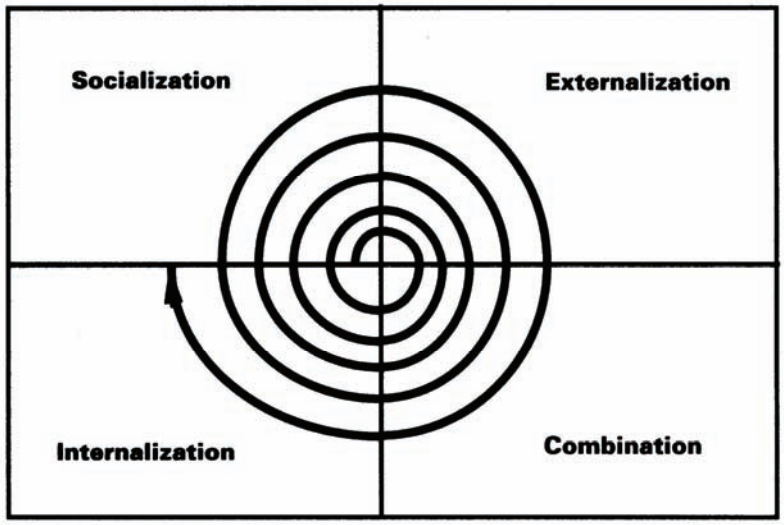
[134] Nonaka, I, Takeuchi, H. 1995.

[135] For example: Hussi, T. 2004; Merx-Chermin, M and Nijhof, W. 2005; Melkas, H, Harmaakorpi, V. 2008; Popadiuk, S, Choo, C. 2006.

[136] Gourlay, S. 2006. 1415.

to further theories being built on a shaky foundation.[137,138] Nonaka's theory has been described as one of the best known and influential models in knowledge strategy literature[139] and as highly respected.[140]

Nonaka's theory builds on the premise that tacit and explicit knowledge are two discrete forms of knowledge, although mutually complementary, and that new knowledge is created through social interaction between the two, a process labelled as knowledge conversion. This process occurs between individuals and not within a single individual.[141] It is worth noting that Nonaka's theory is about individual knowledge creation in a social organisational setting. The knowledge becomes organisational when it is transferred from the individual to a group, from group to department, from department to organisation.



The crux of Nonaka's theory[142], the "SECI engine of knowledge creation" has been used by many researchers as basis to build further theories and refinements. It assumes that knowledge is created through the interaction between tacit and explicit knowledge and postulates four different modes of knowledge creation: (i) Socialisation, which describes the conversion of tacit knowledge into tacit knowledge; (ii) externalisation – the conversion of tacit knowledge into explicit knowledge; (iii) combination – converting explicit knowledge into explicit knowledge; and (iv) internalisation – converting explicit knowledge into tacit knowledge.

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[137] Exactly how widely Nonaka's work is used is evident from a simple Google Scholar search revealing that Nonaka and Takeuchi's 1995 book has been cited 3591 times up to February 2008.

[138] An example of a paper building on Nonaka's theory is that of Al-Hawari and Hasan (Al-Hawari, M, Hasan, H. 2002) where Nonaka's model is combined with the I-Space framework of Boisot (see below) to create a new model, the K-Space.

[139] Choo, C, Bontiss, N. 2002. ix.

[140] Easterby-Smith, M, Lyles, M. 2003. 11.

[141] Nonaka, I, Takeuchi, H. 1995. 61.

[142] Nonaka's theory is summarised from Nonaka, I, Takeuchi, H. 2005. 62-73.

Socialisation is the acquisition of tacit knowledge by people who do not have it from people who do and depends on the sharing of experiences, as in the transfer of knowledge between craftsman and apprentice or on-the-job training in business.[143]

Externalisation happens when tacit knowledge is converted into explicit concepts. It is triggered by a process of dialogue or collective reflection and becomes evident in the shape of metaphors, analogies, concepts, hypotheses or models. Nonaka stresses that externalisation holds the key to knowledge creation because it creates new explicit concepts from tacit knowledge.

Combination converts explicit knowledge into explicit knowledge and happens when different bodies of explicit knowledge are combined into a knowledge system. Formal education and training fall into this category.

Internalisation involves embodying explicit knowledge into tacit knowledge and is related to learning by doing. Experiences are internalised in the form of shared mental models or technical know-how.

Organisational knowledge creation is a continuous process of interaction between tacit and explicit knowledge. This knowledge is organisationally amplified through the four modes of knowledge conversion and "crystallized at higher ontological levels", i.e. the knowledge is transferred from individual to group to department to division to organisation. They describe five conditions that enable and promote organisational knowledge creation, namely, intention, autonomy, fluctuation and creative chaos. The final part of the theory is a five step organisational knowledge creation process: sharing of tacit knowledge, creating concepts, justifying concepts, building archetypes and cross-levelling knowledge.

Parts of Nonaka's theory have undergone considerable modification since first publication, but the "SECI engine" has remained largely unchanged as central element[144] and what follows will concentrate thereupon.

Nonaka's theory has had a great impact on the literature on organisational knowledge creation, but essentially only describes ways of appropriating individual knowledge for

[143] Devlin (Devlin, K. 1999. 162) refers to the acquisition of knowledge in this way as "knosmosis", analogous to osmosis, which he describes as "the biological process whereby a cell absorbs nutrients through the cell wall". His description refers to a special case of osmosis.

[144] Gourlay, S. 2006. 1416.

organisational purposes and its fundamental flaws have been decisively underscored by a number of scholars in citing both conceptual as well as empirical deficiencies[145].

Nonaka's critical epistemological assumption that tacit knowledge and explicit knowledge are two distinct but complementary types of knowledge that can be converted from one form to the other is the basis for the theory[146] and has been shown to be unsound. The understanding of tacit knowledge to be "knowledge-not-yet articulated – knowledge awaiting its 'translation' or 'conversion' into explicit knowledge … is erroneous: it ignores the essential ineffability of tacit knowledge, thus reducing it to what can be articulated. … Tacit knowledge cannot be 'captured', 'translated' or 'converted', but only displayed – manifested – in what we do. New knowledge comes about not when the tacit becomes explicit, but when our skilled performance – our praxis – is punctuated in new ways through social interaction".[147] If Polanyi's work had really been engaged with, it would have been noticed that all knowledge has tacit presuppositions and that tacit knowledge cannot be converted into explicit knowledge, preventing researchers like Nonaka to use such a false claim as the basis for their theories.[148] Cook and Brown[149] support the view that tacit and explicit knowledge cannot be converted from one form into the other, but proposes that one form can be used as an aid in acquiring the other. Gourlay[150] points out that socialisation and combination are not modes of knowledge conversion, but rather simply modes of knowledge transfer.

Nonaka and colleagues constructed self-completion questionnaires to test his theory of knowledge creation and had responses from 105 Japanese male middle managers in 1993.[151] Analysis of these questionnaires was used to validate the SECI hypothesis. An analysis of the questionnaires leads Gourlay to conclude that the study concentrated on semantic information creation and not on knowledge conversion. Even when ignoring this conclusion, confirmatory factor analysis only explained socialisation and combination, but did not provide sufficient support for externalisation and internalisation,[152] representing the fundamental tacit to explicit

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[145] Gourlay, S. 2006. 1430.

[146] Nonaka, I, Takeuchi, H. 1995. 61.

[147] Tsoukas, H. 2005. 158.

[148] Tsoukas, H, Vladimirou, E. 2005. 119.

[149] Cook, S, Brown, J. 1999. 385.

[150] Gourlay, S. 2006. 1421.

[151] Nonaka et al. 1994.

[152] Which, as has been pointed out, are essentially knowledge transfer processes.

and explicit to tacit conversion processes upon which the theory is based.[153] A major limitation of Nonaka's theory is that it does not explain how the knowledge conversion process could lead to completely new tacit knowledge arising within an individual.[154]

Other, more detailed criticisms on aspects on Nonaka's theory can be found in Yolles,[155] Bereiter,[156] Engestrom,[157] Essers and Schreinemakers,[158] and Jorna[159].

It is important to note that the organisational knowledge creation process is predicated upon human interaction in a social organisational context. Tsoukas'[160] view of the firm as a distributed knowledge system composed of knowledge embodied in individuals and their social interactions implies the promotion of interaction between individuals to create new knowledge. This dimension will be revisited later when it will be argued that organisational knowledge *emerges* as a result of social human interaction. Un and Cuervo-Cazurra[161] expands on this by pointing out that the creation of knowledge in a firm is better accomplished between interacting individuals with different knowledge sets rather than with similar knowledge sets and that such interaction should be multidirectional enabling people to become both sources and recipients of knowledge. They identify two key prerequisites for knowledge creation through interaction, namely (i) willingness to share knowledge and (ii) understanding amongst the sharers, i.e. there should exist a common code, common knowledge or overlapping knowledge. In summarising assumptions that inform the work of researchers in the field of organisational and economic significance of knowledge, Grant[162] identifies one key assumption as being that (organisational) knowledge is created by human beings who carry out work and interact in the context of social practices. Social interaction in the organisational context is also accentuated by Tsoukas and Mylonopoulos[163] in saying "organizational members draw on stocks of existing knowledge and interact with one another

[153] Gourlay, S, Nurse, A. 2005. 296-297.
[154] Stacey, R. 2000. 25.
[155] Yolles, M. 2000.
[156] Bereiter, C. 2002.
[157] Engestrom, Y. 1999.
[158] Essers, J, Schreinemakers, J. 1997
[159] Jorna, R. 1998.
[160] Tsoukas, H. 1996.
[161] Un, C, Cuervo-Cazurra. 2004. S29.
[162] Grant, R. 2002. 138.
[163] Tsoukas, H, Mylonopoulos, N. 2003. 911.

(as well as with others outside the organization) to solve particular problems and tackle particular issues. By doing so, individuals create new knowledge."

In 1999 Cook and Brown[164] followed Nonaka with an equally polymerous view of knowledge and its creation in the organisational context. They identify four types of knowledge in an epistemology of possession, namely *explicit* and *tacit*, *individual* and *group*. Each of these four types are independent of and on equal footing with all the others. None could be derived from or converted into any other. They also identify another dimension, the epistemology of practice, as that which is part of action: knowing. To clarify, they state that there is "both knowledge *used* in action and knowing *as part of* action. … we do not see knowledge and knowing as competing, but as complementary and mutually enabling".[165] (Emphasis in the original). New organisational knowledge is created when the epistemology of possession and the epistemology of practice are bridged in a "generative dance".

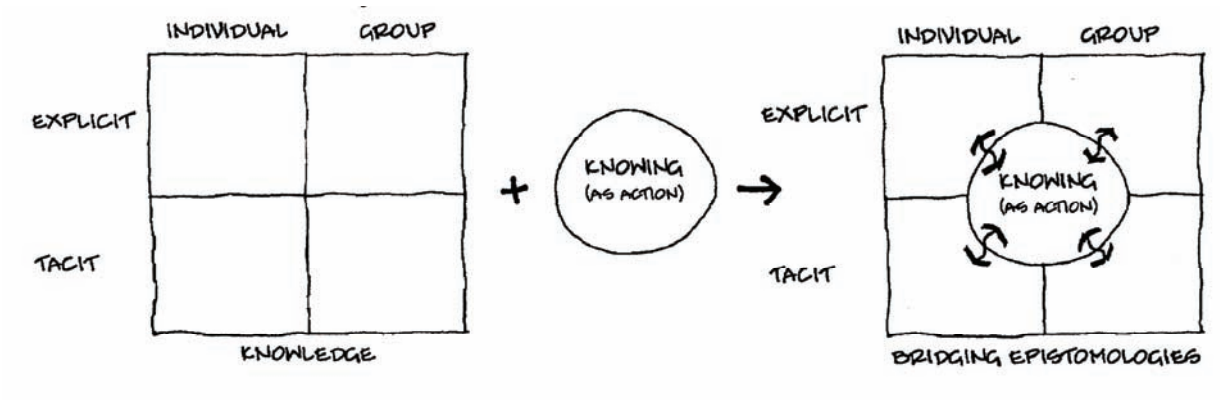

Figure 6 - Knowledge and Knowing, from Cook, S, Brown, J. 1999. 383.

Although Cook and Brown claim that their view of tacit and explicit knowledge is in agreement with Polanyi, it remains difficult to reconcile their conceptualisation with that of Polanyi where all knowledge is grounded in tacit knowledge. Cook and Brown are part of the school that claims that tacit and explicit knowledge are quite distinct, in opposition to those who see the two types as the ends of a continuum.[166] While they hold that one type cannot be converted into the other, many of the criticisms levelled at Nonaka and Takeuchi's conceptualisations of the tacit/explicit distinction are also applicable to their outlook. They warn that knowing should not be confused with tacit knowledge, which "is a tool or an aid to

[164] Cook, S, Brown, J. 1999.

[165] Cook, S, Brown, J. 1999. 383.

[166] Cook, S, Brown, J. 1999. 399.

action, not part of action itself",[167] but the widespread equating of tacit knowledge with knowing leads to confusion which is not dealt with adequately. Orlikowski[168] contends that it is problematic to separate the process of knowing and its resulting knowledge, which is exactly what they do. Orlikowski recognises that Cook and Brown's introduction of knowing effectively assumes that tacit knowledge is separate and distinct from knowing, and thus from action and argues that tacit knowledge is knowing and thus inseparable from action.[169]

Firestone and McElroy[170] distinguish between three tiers of business processes, namely (1) operational business processes that uses knowledge; (2) knowledge processes, comprising knowledge production and knowledge integration and (3) processes for managing knowledge processes. Knowledge production consists of four sub-processes: (i) information acquisition; (ii) individual and group learning; (iii) knowledge claim formulation, and (iv) knowledge claim evaluation. In an organisation operational processes are performed by individuals and groups using prior knowledge found in the distributed organisational knowledge base ("DOKB").[171] Sometimes the DOKB does not provide the answers in a perceived situation, indicating an epistemic gap between what is known and what is needed to be known to perform the operational process. This situation initiates a knowledge production process. Solutions are formulated, coming from new learning, information acquisition or creative knowledge claim formulation; or all three. Knowledge is not produced until the tentative solutions (knowledge claims) have been tested and evaluated in the knowledge claim evaluation sub-process.[172] This newly produced organisational knowledge is then integrated into the DOKB, thereby erasing the epistemic gap that initiated this process which the authors labelled the Knowledge Life Cycle.

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[167] Cook, S, Brown, J. 1999. 388.

[168] Orlikowski, W. 2002.

[169] Orlikowski, W. 2002. 251.

[170] Firestone, J, McElroy, M. 2004.

[171] The distributed organisational knowledge base has electronic storage components, but also documents and non-electronic media. This is not consistent with the definition of knowledge and organisational knowledge developed in 2.3 and 2.4 above and in the context of this study is seen as information (which could become knowledge). The authors however add that the distributed organisational knowledge base also includes all mental knowledge in the enterprise.

[172] This is similar to the *justification* in the definition of knowledge as true justified belief (see 2.2 above).

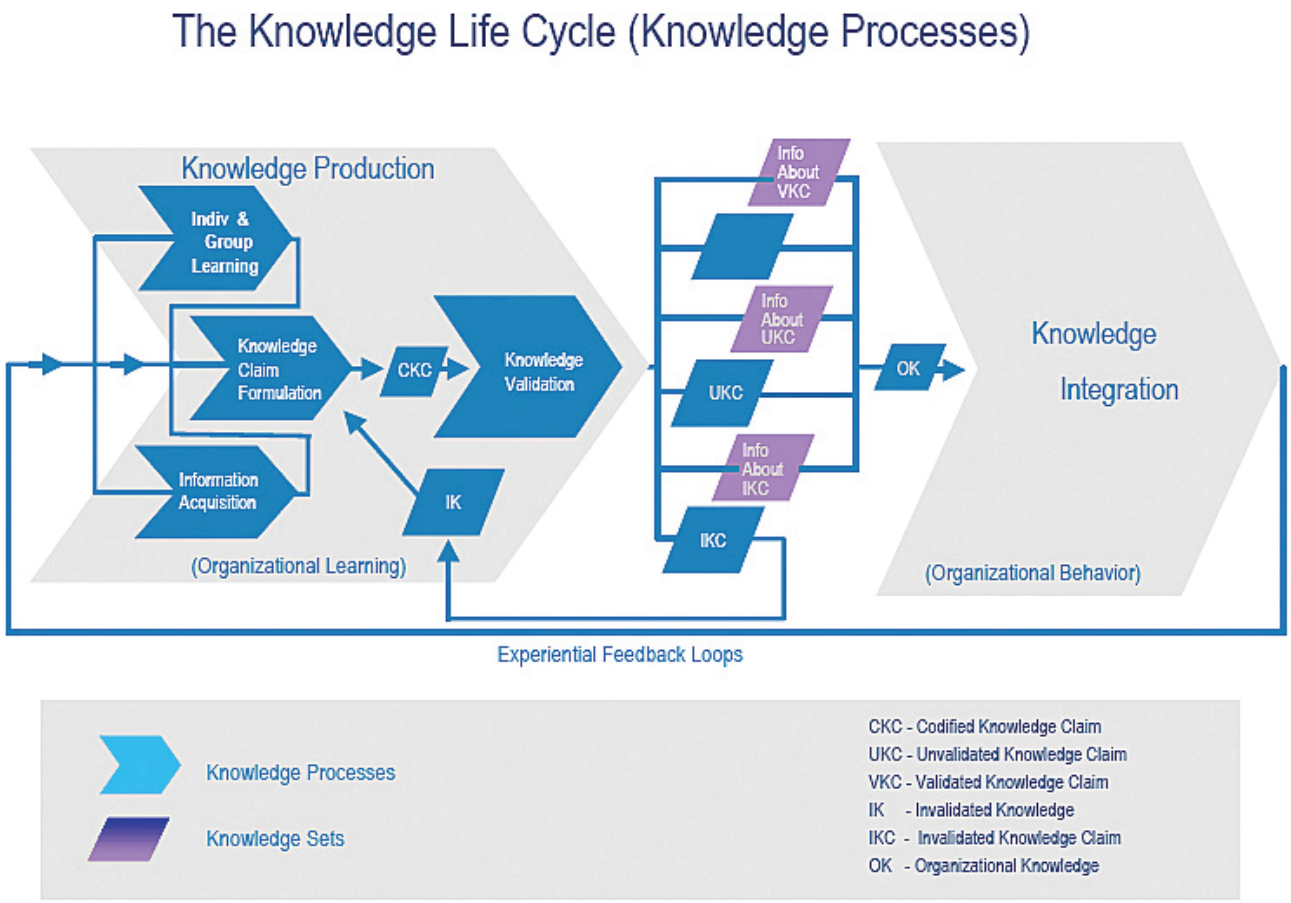

Figure 7. The Knowledge Life Cycle from a presentation by Mark McElroy at the ICM conference on Knowledge Management, April 1999, Miami, Florida.

Firestone and McElroy are knowledge management practitioners and have developed their framework (of which the knowledge production process summarised in the previous paragraph is but a tiny part) to delimit knowledge management and relate it to concepts such as organisational learning. Max Boisot's Social Learning Cycle provides a more profitable avenue for the purpose of relating organisational knowledge creation to complexity and sensemaking.

The section of the Social Learning Cycle (SLC) that is relevant is that part of the cycle where new knowledge is generated. In order to understand how this happens, Boisot's three dimensional epistemological space must be examined.

Unlike Nonaka and Takeuchi's two dimensional plane using their problematic distinction between tacit knowledge and explicit knowledge, Boisot utilises the interaction between three knowledge attributes, codification, abstraction and diffusion to create a three dimensional

space, the Information Space (I-Space) within which an organisation follows the SLC.[173] Although the codification attribute is in conflict with the knowledge definitions developed here earlier, it will become apparent later that the section of the SLC of interest could equally have been conceived in harmony with those definitions on a plane with only abstraction and diffusion as dimensions.

The codification attribute is scaled according to a complexity definition, namely the number of bits of information required to carry out a given data-processing task.[174] The codification dimension of the I-Space could therefore also be seen as a complexity dimension, with *complex* corresponding to *uncodified* and *simple* corresponding to *codified*. Boisot refers to the distinction between tacit and *codified* knowledge, using *codified* synonymously with *explicit*, but also mentions that codification implies more than just being able to set down an item of knowledge on paper. The process of codification creates perceptual and conceptual categories that facilitate the classification of phenomena.[175] The less codified a task, the greater the time required to assign events to categories and hence the larger the number of bits of data that have to be processed to complete it. Codification can be thought of as a procedure for shedding surplus data and hence for economising on data processing. Using total codification and totally uncodified attributes of a task as the poles of a continuous scale, the uncodified end will accommodate tasks that require the processing of an infinite number of bits for their resolution. Such tasks are ineffable, unintelligible and incommunicable. At the totally codified end of the scale will be tasks that are simple and only need one bit of data for their execution. Complete codification will allow a task to be performed by a machine without human intervention.[176]

Abstraction gives structure to phenomena. It allows causal or descriptive structures underlying data to come into focus. Abstraction is a form of reductionism: it captures the condensed essence or patterns of regularities underlying a data stream or task. At one end of the abstraction scale will be highly concrete experiences where knowledge is perceptual and

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[173] The discussion of I-Space and the SLC is based on (i) Boisot, M. 1995. 145-231 and (ii) Boisot, M. 1998. 41-69 .

[174] Although Boisot states that this definition refers to what is known as Algorithmic Information Complexity (or Content), it is closer to the definition of *crude complexity* offered by Gell-Mann (Gell-Mann, M. 1994. 34) as the length of the shortest message that will describe a system, at a given level of coarse graining, to someone at a distance, employing language, knowledge and understanding that both parties share (and know they share) beforehand.

[175] Boisot, M. 1998. 42.

[176] Boisot, M. 1998. 44-47.

local. At the other end will be abstract thought and knowledge will be conceptual and general.

Both codification and abstraction are data-shedding devices and working together make knowledge articulate and shareable.[177]

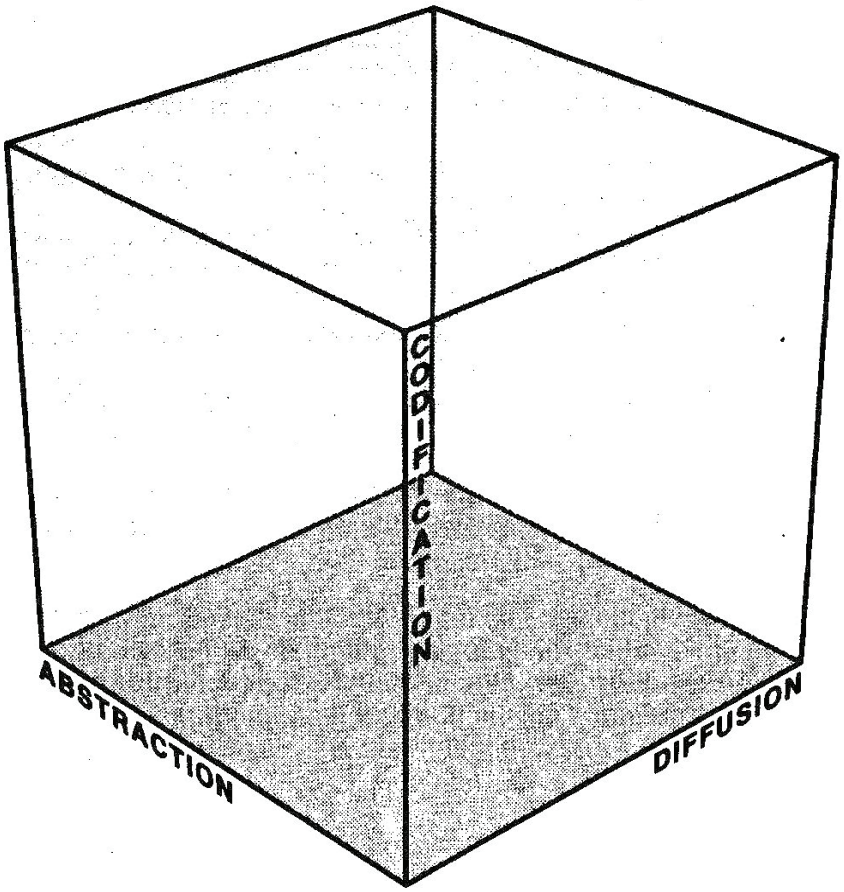

Figure 8. The I-Space. Boisot, M. 1995. 166

The diffusion dimension measures to what extent knowledge is shared with others. Undiffused knowledge stays locked inside a person's brain, either because it is tacit or because the choice has been made not to share it. Diffused knowledge at the other end of the scale is widely shared among people. Diffusability is the availability of data and information

[177] Interestingly Tsoukas connects codification and abstraction to the process of converting personal knowledge into organisational knowledge: "… knowledge becomes organizational when, as well as drawing distinctions in the course of their work, … *individuals draw and act upon a corpus of generalizations in the form of generic rules, produced by the organization"* (emphasis in the original). (Tsoukas, H. 2005. 124.) Also: "… what makes knowledge distinctly organizational is its codification in the form of propositional statements underlain by a set of collective understandings." (Tsoukas, H. 2005. 135.).

for those who want to use it whereas diffusion is the extent that the data or information has been shared in the population.[178]

The codification, abstraction and diffusion properties are brought together as the three dimensions of a conceptual framework, the I-Space where the creation and diffusion of knowledge within selected populations can be understood. It should be emphasised that the selected population could represent an organisation, hence the relevance of the I-Space and the SLC as a theory of organisational knowledge creation.

Boisot argues that codification and abstraction are mutually reinforcing and acting together facilitate the diffusion of information.[179] The more codified and abstract an item of information becomes, then, all other things being equal, a larger percentage of a given population it will be able to reach in a given time. This is represented by the diffusion curve shown in figure 9. At point A knowledge is idiosyncratic and tacit; as it is transformed into codified information and becomes more abstracted, it also becomes more diffusable and, given no blockages (e.g. proprietary knowledge being kept secret), it diffuses into a wider population (point A'). Point A on the curve can be likened to the world of Zen Buddhism where knowledge is highly personal and hard to articulate. It must be transmitted by example rather than by prescription. Examples are often ambiguous and open to interpretation. Zen knowledge can therefore only effectively be shared on a face-to-face basis with trusted disciples over extended periods of time. In contrast, point A' describes the world of bond traders where all knowledge relevant to trading has been codified and abstracted into prices and quantities. This diffuses instantly from trading screen to trading screen instantaneously

[178] Al-Hawari and Hasan (Al-Hawari, M, Hasan, H. 2002. 94) define diffusion as "the availability of information and knowledge for sharing, transmission and interchanging inside and outside the organisation". This is actually a definition of diffusability and ignores Boisot's insistence that the I-Space is applicable only to a defined population. They also demonstrate a misconceptualisation of *tacit knowledge* by stating: "… completely tacit knowledge … is not easy to diffuse by technology until it is completely codified"!

[179] Although Boisot made a very clear distinction between data, information and knowledge elsewhere and years later (Boisot, M, Canals, A. 2004), his usage of the terms *information* and *knowledge* in these earlier works are at times infuriatingly conceptually intermingled.

and globally. Face-to-face relationships and interpersonal trust is not needed, only trust in the

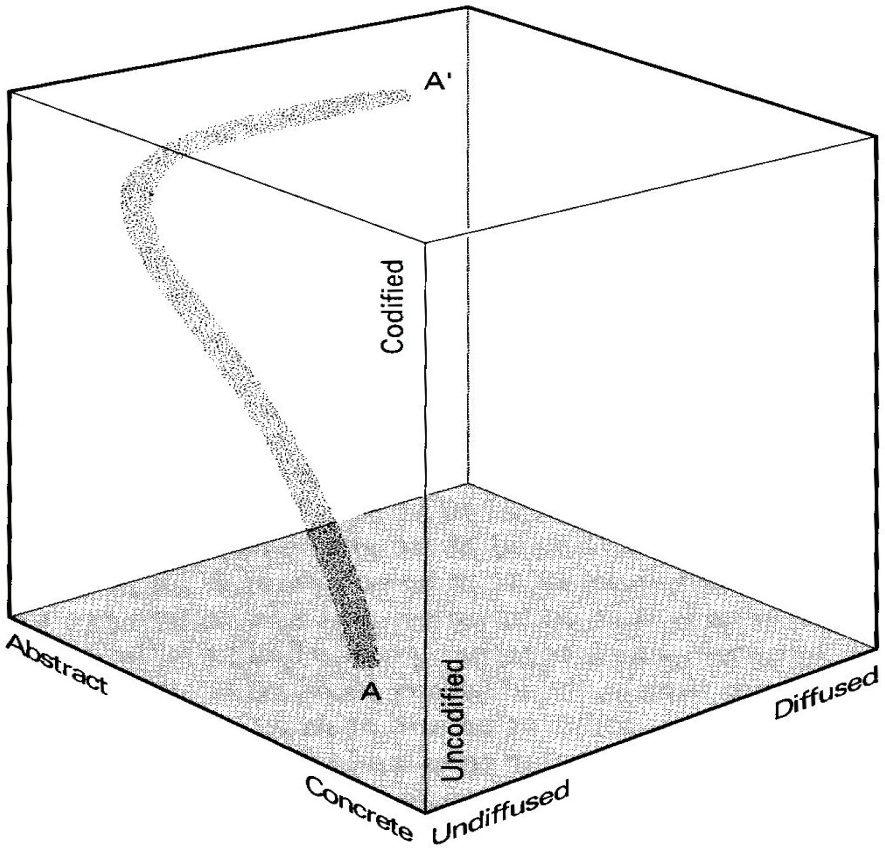

Figure 9. The Diffusion Curve in I-Space from Boisot, M. 1998. 56.

supporting

technical and legal system is necessary.[180]

Movement also occurs from point A' back to point A, albeit not along the same path. Over time codified information gets internalised, abstract information is applied in concrete situations and diffused information gives rise to unique insights which are appropriated by individuals. While not stated as such by Boisot, the move from codified to uncodified and from abstract to concrete could be interpreted as learning, i.e. the appropriation of existing knowledge by individuals and the movement low in the I-Space from diffused to undiffused, characterised by unique insights, as the creation of new knowledge.

The social learning cycle (SLC)[181] describes knowledge flows, from the creation and diffusion of *new* knowledge and through absorption back to the start of the cycle and which tends to happen in a particular sequence in six phases:

[180] Boisot, M. 2000. 119.

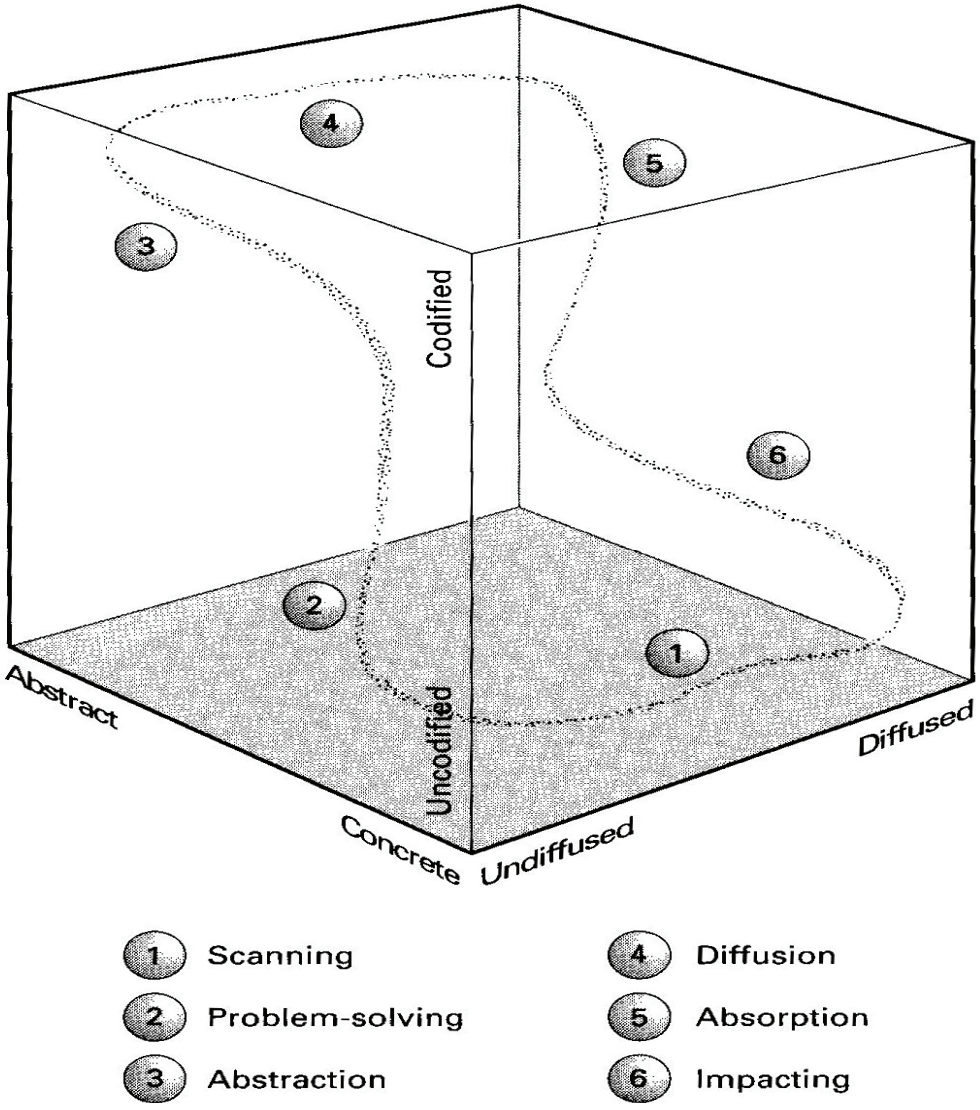

Figure 10. The Social Learning Cycle from Boisot, M. 1998. 60

Scanning: Finding patterns in fuzzy data resulting in unique, idiosyncratic insights appropriated by individuals or small groups. Signals from outside the given population of the I-Space may enter here. This is where new knowledge gets created.

Problem-Solving: Giving structure and coherence to the insights, i.e. codifying them.

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[181] There are certain parallels between the SLC and Firestone and McElroy's Knowledge Life Cycle: *scanning* could be mapped to *information acquisition* and *individual and group learning*; *problem solving* and *abstraction* to *knowledge claim formulation* and *knowledge validation*; and *diffusion, absorption* and *integration* could represent *knowledge integration.* There are also parallels between the SLC and Nonaka's SECI process: *scanning* could be seen as *socialisation*; *problem solving* and abstraction as *externalisation*; *diffusion* as *externalisation* to higher ontological levels, and finally *absorption* and *impacting* could represent *internalisation.*

Abstraction: Generalising the application of the newly codified insights to a wider range of situations.

Diffusion: Sharing the codified and abstracted insight with a wider population.

Absorption: Applying the new generally available insight and learning by using them.

Impacting: Embedding the insight in concrete practice. Absorption and impacting (like codification and abstraction) often work in tandem.

Boisot sees the SLC as a mechanism to describe the creation, distribution and absorption of *new* knowledge that can be extracted from what is available in the data field.[182]

The *scanning* phase of the SLC warrants closer attention, as this is where new knowledge is created. The SLC moves from the area where entropy is at a maximum in the lower right hand side of the I-Space towards the lower left, where knowledge is ready for codification and abstraction. Only data fluctuations can drive the SLC along this path, generating far-from-equilibrium states and generating stable, discernible patterns that emerge.[183] The outcome of the scanning process is new knowledge which is created by spotting promising new and novel patterns in generally available data, leading to destabilising insights that will drive the system into a new and ordered far-from-equilibrium state on the left of the I-Space. Order, in the form of new knowledge, emerges out of chaos, both states being necessary for a proper functioning of the SLC.[184] Scanning is of course also possible in the higher reaches of I-Space where it stimulates exploitative learning, but only uncodified scanning in the lower reaches leads to exploratory learning,[185] i.e. the discovery of new knowledge. Stimuli that provoke radically new knowledge creation will travel from right to left predominantly in the lower regions of the I-Space, in the uncodified realm, where they are hard to categorise with any confidence.[186]

While Boisot explores many subtleties of the I-Space and the SLC, it is not necessary or relevant to delve deeper into those intricacies for the purposes of the argument being

[182] Boisot, M. 1995. 187.
[183] Boisot, M. 1998. 68.
[184] Boisot, M. 1998. 80-81.
[185] Boisot, M. 1998. 194.
[186] Boisot, M. 1995. 192.

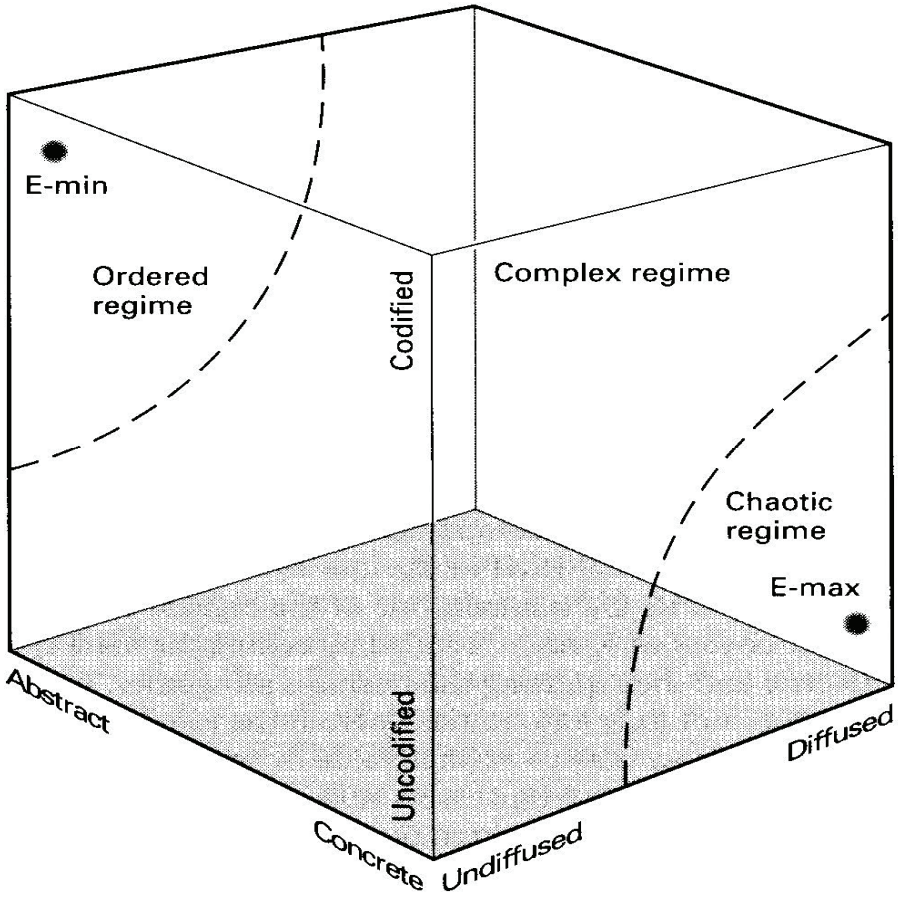

Figure 11. Ordered, Complex and Chaotic regimes in the I-Space from Boisot, M. 1998. 69

constructed here. Some of the propositions that Boisot derives from I-Space, however, would be helpful. In the region of I-Space where codification and abstraction is at a maximum, but diffusion remains at a minimum, is where the information environment is at its most ordered and entropy[187] production is at its minimum, represented by E-min in figure 11. This is the ordered regime. There is also a region of maximum entropy, E-max, where diffusion is pervasive and no pattern or structure can be identified in data streams. This is the chaotic regime. Between order and chaos is the phenomenon of complexity, a concept which will be investigated in the next chapter. Boisot's SLC provides the link between organisational knowledge creation and complexity, concentrating on the epistemological aspects.[188] The

[187] Entropy is a measure of disorder. Entropy and information are closely related and entropy can be regarded as a measure of ignorance. (Gell-Mann, M. 1994. 219).

[188] A remarkable parallel to Boisot's SLC is found in the much earlier work of von Foerster arguing that self organisation progresses in two ways: order from order, and order from noise. A self organising social system steadily increases its level of order, new structures emerge and the system expands (order from order). But at

same link will be scrutinised from the point of view of complexity in order to pay closer attention to the way in which complexity acts as catalyst for knowledge creation.

Meszaros[189] points out that there is a link between Boisot's model, complexity models and sensemaking as the model implies multi-linear and multifinal learning paths as each actor integrates new knowledge into their own frames and systems of sensemaking, implying that a single piece of knowledge may move actors in any number of different directions.[190]

2.6 Waypoint #1

The journey that will end at a view of how organisational knowledge is created under conditions of complexity has reached its first waypoint: a usable depiction of the process whereby organisational knowledge is created, hinting at the possibility that chaotic conditions might provide the stimuli to knowledge creation. En route the concept of *knowledge* was constrained to mean *the expectations, modifiable by perceived information, residing in the human brain, allowing plausible interpretations of the environment and used in determining appropriate action.* Organisation was depicted as *a grouping of people bound together in a collective social entity by the pursuit of an organisational goal set by those in power, characterised by shared understandings and the application of knowledge.* There was a need to discriminate between individual and organisational knowledge and the latter was described as *the aggregate of both the distributed and common knowledge held by individual members of the organisation, applied in the organisational context, the application of which is shaped and guided by power relations and the unique idiosyncratic organisational context and history in which it is utilised.* Finally, theories of organisational knowledge creation were inspected and Boisot's SLC, which provides a link between organisational knowledge creation and chaotic conditions, was adopted to carry forward on this expedition of discovery.

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a certain threshold quantity turns into quality and the structures of the social system fluctuate and enter a period of disorder. From this disordered state of the system, new order emerges – order from noise. (von Foerster, H. 1960. 227). When order is used as proxy for knowledge, the SLC concept could arguably be derived with aspects of von Foerster's work as point of departure.

189 Meszaros, J. 2000. 122.

190 The capacity to produce an unexpected and original insight is a mark of creativity, but might lead to being classified as a deviant (Boisot, M. 1995. 222). Research done at Vanderbilt University on people with schizotypal personalities (people characterised by odd behaviour, i.e. people who could be classified as deviants) offers neurological evidence that they are more creative.

Chapter 3
Complexity as Catalyst for Knowledge Creation

3.1 Complexity is the natural state of affairs

Around 2500 years ago, the Greek philosopher Heraclites noted that "you cannot step twice into the same river, for other waters are continually flowing on." He was one of the first Western philosophers to address the idea that the universe is in a constant state of flux, embodying characteristics of both permanence and change.[191]

It has become apparent that the fundamental laws governing elementary particles, like quarks[192], and thus the complete known universe and everything contained therein, are quite simple. These, combined with chance, have resulted in many ways in which history[193] has evolved along certain paths and not others. Chance enters the picture because the fundamental laws are quantum-mechanical and certainties do not exist in a quantum-mechanical universe, only probabilities for alternative histories. This indeterminancy could lead to chaos, which is the phenomenon where the slightest imprecision in initial conditions can lead to arbitrarily large uncertainties in future predictions.

On certain branches of history conditions are propitious for the evolution of complex adaptive systems. These are systems that find perceived regularities in a datastream from its environment, while treating the rest of the stream as random. These regularities are compressed into a schema[194] which is employed to describe the world, predict its future and to prescribe behaviour of the complex adaptive system itself. The schema undergoes changes and many variants are produced, the success and longevity of which are determined by

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[191] Morgan, G. 1997. 251.

[192] A fundamental sub-atomic particle which is one of the two basic constituents of matter (the other is the lepton) and is the building block for protons and neutrons.

[193] *History* is used in the sense of a possible sequence of events over time, not necessarily what has already taken place in the past. Each alternative history of the universe depends on the results of an inconceivably large number of accidents (Gell-Mann, M. 1994. 133).

[194] *Schema* is used here in a sense similar to *knowledge*.

feedback from the real world reflecting the accuracy of the schema or its ability to contribute to the survival of the system.[195]

Complex adaptive systems function best in a regime between order and disorder. They exploit regularities and profit from the indeterminancies which assist in discovering better schemata. The comfort zone for complex adaptive systems is sometimes called "the edge of chaos", but is perhaps better characterised as the domain of complexity.

Higher levels of organisation are sometimes reached by aggregation of complex adaptive systems into a composite complex adaptive system. This composite system then consists of adaptive agents constructing schemata to account for and deal with one another's behaviour.[196]

It is quite clear from the foregoing that humans are complex adaptive systems[197], their schemata represent knowledge and that organisations are *composite* complex adaptive systems[198] and that they all exist in the zone of complexity "at the edge of chaos". Where once the natural world was viewed as linear and mechanistic, where simple cause-and-effect solutions were expected to explain the complex phenomena of nature, scientists now realise that much of their world is non-linear and organic, characterised by uncertainty and unpredictability.[199] Also in the business world the spirit of Moore's Law – The speed of computer chips would double every 18 months while their costs would halve – has spread beyond microprocessors and memory chips to the organisational domain where strategists are today expected to deal with an increasing number of variables and ever more elusive, non-linear interactions between them: a formidable increase in the objective complexity of a firm's strategic agenda.[200] The natural environment for an organisation is not order, where it might ossify due to excessive regularity and no uncertainty, neither is it complete disorder, where it might disintegrate due to the total unpredictability of the world, but it is in the complexity domain. Complexity explains and thus helps us to understand the nature of the world – and the organisations – we live in.[201] Complexity theory describes the world as it

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[195] Knowledge acquired in this manner could also be subject to error. *Superstition* typically involves seeing order where there is none. *Denial* amounts to rejecting evidence of regularity. (Gell-Mann, M. 1994. 276.)

[196] Adopted from Gell-Mann, M. 1994. 367-374.

[197] Gell-Mann, M. 1994. 89.

[198] Lewin, R, Regine, B. 2003. 168.

[199] Gallagher, R, Appenzeller, T. 1999.

[200] Boisot, M. 2000. 114.

[201] Mitleton-Kelly, E. 2003. 26.

is.[202] The investigation of organisational knowledge creation must of necessity at least clarify the domain of complexity.

There is still a lack of agreement in the literature on a taxonomy that embraces the concepts of non-linear systems, chaos theory and complexity theory. This is not a question that needs to be addressed in this study and neither is there any intention to provide an exposition of chaos theory or complexity theory – the explanation of certain selected concepts will suffice in order to clarify the hypothesis being investigated. *Order*, *complexity* and *chaos* will be investigated in order to show that the world around us is a complex one and that it exhibits qualities that are generally associated with chaos. A very important feature of complex systems to be discussed is *emergence*. It will be argued later that new knowledge emerges in organisations operating in the complex conditions at the edge of chaos. It is also necessary to briefly inspect *complex adaptive systems*, as it will be argued that contemporary organisations are in fact composite complex adaptive systems and therefore governed by the principles of complexity. Finally, it is necessary to look at complexity as catalyst for the creation of new knowledge.

Studies of complexity in human organisations[203] draw on literature from diverse fields such as biology, chemistry, computer simulation, evolution, mathematics and physics, and concepts from work on *complex adaptive systems*,[204] *dissipative structures*,[205] *autopoiesis*,[206] and *chaos theory*.[207]

Underlying the discussion that follows is the assumption that everything around us (ourselves included) is interconnected and interrelated, a key insight of systemic thinking[208].

3.2 Order, Complexity and Chaos – a whirlwind tour

March[209] identifies three ideas involved in classic conceptions of order:

- *Reality*, the idea that there is an objective world that can be perceived and that only one such world exists – history is real.

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[202] Joubert, C. 2005. 110.
[203] Joubert, C. 2005. 101.
[204] Kauffman, S. 1995, Holland, J. 1998.
[205] Nicolis, G, Prigogine, I. 1989.
[206] Luhmann, N. 1990, Maturana, H, Varela, F, 1987.
[207] Gleick, J, 1997.
[208] Flood, R. 1999. 91.
[209] March, J. 1994. 176.

- *Causality*, the idea that reality and history are structured by chains of causes and effects.
- *Intentionality*, the idea that decisions are instruments of purpose and self.

He argues that these conceptions of order seem to underestimate the confusion and complexity of reality.

Kurtz and Snowden[210] also question the universality of certain assumptions permeating organisational theory and practice, namely:

- *The assumption of order*: that there are underlying relationships between cause and effect in human interactions and markets which are capable of discovery and empirical verification.
- *The assumption of rational choice*: that faced with a choice between one or more alternatives, human actors will make "rational" decisions based on minimising pain or maximising pleasure.
- *The assumption of intentional capability*: that the acquisition of capability indicates an intention to use that capability and that actions are the result of intentional behaviour.

There has been a growing awareness that order may not be the natural state of affairs and the domain outside the boundaries of order should therefore be investigated.

It is quite natural to see *chaos* as confusion or disorder as it is used in everyday language. In complexity theory the phenomenon of chaos refers to conditions where the outcome of a non-linear dynamical process is so sensitive to initial conditions that a miniscule change in the situation at the beginning of the process results in a large difference at the end.[211] Chaos is the evolutionary behaviour of a system that depends so delicately on the system's exact initial conditions that it is effectively arbitrary and indistinguishable from a random process, even though it is deterministic in a mathematical sense. Chaos theory describes non-linear dynamics based on the iteration either of a mathematical algorithm[212] or a set of simple

[210] Kurtz, C, Snowden D. 2003. 462-463.

[211] Gell-Mann, M. 1994. 25.

[212] Consider the example of Lorenz, who in 1963 discovered that merely rounding off a set of numbers and feeding them back to very simple equations suffices to generate unpredictability about the outcome (Tsoukas, H. 2005. 211.)

rules[213] of interaction, both of which can give rise to extraordinarily intricate behaviour such as the intricate beauty of fractals or the turbulence of a river.[214]

Kellert[215] describes chaos theory as "the qualitative study of unstable aperiodic behaviour in a deterministic non-linear dynamical system". The terminology in this definition is explained by Tsoukas[216] as follows:

- A system is *dynamic* when its state changes over time;
- *Non-linearity* means that a small change in a system variable can have a disproportionate effect on another variable;
- As a result of the difficulty of dealing with non-linear equations, a *qualitative* account of the general pattern of the long term behaviour of the system is sought;
- *Unstable behaviour* means that the system never settles into a form of behaviour that resists small disturbances;
- *Aperiodic behaviour* means that the system does not repeat itself.

The last two attributes make exact predictions impossible and produce a series of measurements that appear random. Sensitive dependence on initial conditions is a distinguishing feature of chaotic systems. A consequence is that although prediction of outcomes in a chaotic system is impossible, retrospective explanation of an outcome is achievable.[217]

While chaos in its popular usage is to be understood as a description of anti-order, a synonym for randomness, the scientific usage is closer to non-order and sees chaos as containing and/or preceding order. Order is seen as lying hidden in chaos, but there is also order that emerges from chaos.[218]

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[213] An example cited by Morgan (Morgan, G. 1997. 262) is as follows: "Create a multitude of computerized 'birds', 'bats' or 'fish' that can move in any way they wish. Establish three simple rules: don't bump into one another; keep up with your neighbours; don't stray too far away. The result: dynamic flock patterns where the detailed movements are completely unpredictable, yet reflect the synchronised behaviour of real birds, bats and fish."

[214] Mitleton-Kelly, E. 2003. 43.

[215] Kellert, S. 1993. 2.

[216] Tsoukas, H. 2005. 216-217.

[217] See also the retrospective nature of sensemaking in the next chapter.

[218] Byrne, D. 1998. 16.

Chaos, in the context of this discussion, is simply the name of a technical phenomenon in non-linear dynamics, while *complexity* and *simplicity* are opposing terms: *simplicity* refers to the absence (or near absence) of *complexity*.[219]

In popular usage, complexity refers to the intermediate area between chaos and order.

Ashby's law of requisite variety[220] states that only variety can destroy variety. This means that a system can only be controlled if the would-be controller can command the same degree of variety as the system.[221] Boisot and McKelvey map Ashby's law and the three ontological regimes of chaos, complexity and order onto what they've termed the Ashby Space.[222]

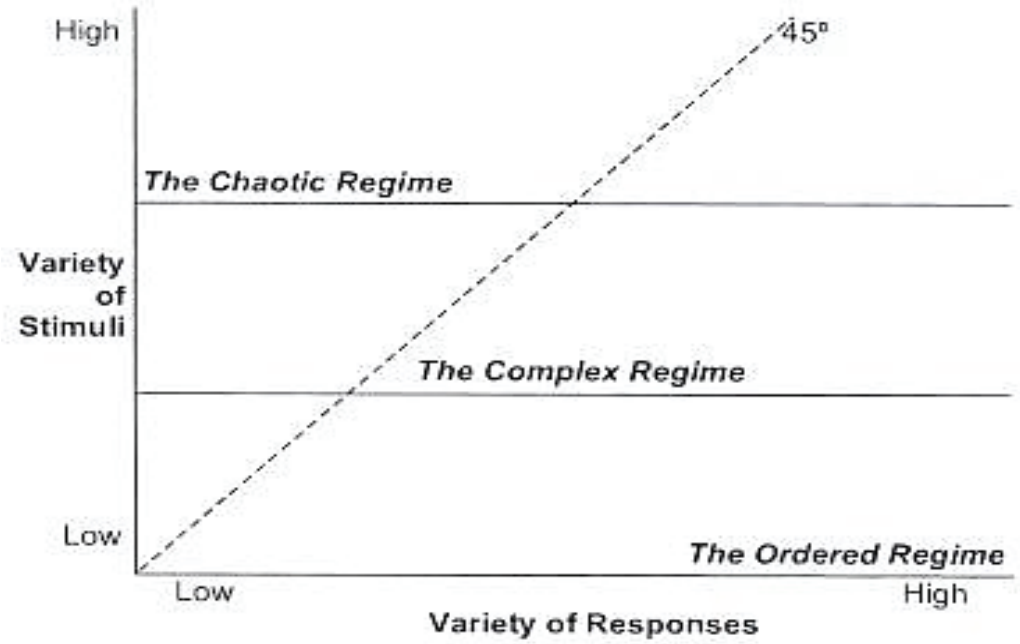

Figure 12. The Ashby Space, from Boisot, M, McKelvey, B. 2007.

On the vertical axis are the real world stimuli that impinge on a system. On the horizontal axis is the system's response schema to the stimuli. The diagonal in the diagram indicates the set of points at which variety can be considered "requisite", i.e. where the variety of a system's response matches that of the incoming stimuli. They argue that stimuli appearing in the chaotic regime are hard to extract useful information from and an intelligent organism can typically make no sense of these stimuli. By contrast, stimuli appearing in the ordered regime are mostly linear and are experienced as unproblematic. Stimuli appearing in the complex

[219] Gell-Mann, M. 1994. 27.

[220] Ashby, W. 1956. 207.

[221] Jackson, M. 2003. 9.

[222] Boisot, M, McKelvey, B. 2007.

regime are experienced as a mix of the predictable and unpredictable, neither too ordered nor so chaotic that no meaningful schema can be mobilised.[223] Variety offers a good proxy measure of complexity.[224]

Gell-Mann distinguishes between different kinds of complexity and possible measures thereof. The computational complexity of a problem is the shortest time in which a computer can produce a solution to that problem.[225] Crude complexity is the length of the shortest message that will describe a system.[226] Algorithmic complexity or algorithmic information content is the length of the shortest computer program to print out a particular message string and then terminate.[227] This is more a measure of randomness than complexity. To overcome this limitation the concept of effective complexity is introduced, being the length of a concise description of an entity's regularities.[228] Potential complexity expresses the likelihood that a system will develop into something more complex in future.[229]

Gell-Mann's effective complexity essentially focuses on the content of information flows between agents. Another approach to complexity is drawn from biology and artificial life and focuses on the structure of the interactions between agents. These views are complementary: the first effectively measures *cognitive* complexity, whereas the latter measures *relational* complexity. In Boisot's I-Space model the codification and abstraction dimensions offer a measure of cognitive complexity, whereas the diffusion dimension captures relational complexity.[230]

Byrne identifies the following characteristics of complexity:[231]

- *Non-linearity*. Attempting to find linear relationships is endeavouring to develop predictive ability, but complex systems do not work in a simple linear fashion and small changes in one variable may lead to large variations in others. Outcomes are

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[223] The Ashby Space would be better represented by shifting the boundaries between the chaotic, complex and ordered regimes away from the horizontal to just above and just below the diagonal at the same 45 degree angle. Boisot only half agrees with this view (personal email communication, 10 April 2008).

[224] Boisot, M, Child, J. 1999. 238.

[225] Gell-Mann, M. 1994. 100.

[226] Gell-Mann, M. 1994. 34.

[227] Gell-Mann, M. 1994. 35.

[228] Gell-Mann, M. 1994. 56.

[229] Gell-Mann, M. 1994. 230.

[230] Boisot, M, Child, J. 1999. 241.

[231] Byrne, D. 1998.18-34.

determined by multiple causes and second and higher order interactions between elements of the system.[232]

- *Extreme sensitivity to initial conditions.* If measurements could be made with extreme accuracy to the degree needed, a complex system could be modelled and predictions could be made. However, such precision in measurement is not possible and small variations in initial conditions lead to unpredictable outcomes[233]. These chaotic[234] outcomes do not in principle mean that causality is abandoned.

- *Bifurcation points.* There are crucial transformation points in the history of a complex system where very small changes in the values of (a) controlling parameter(s) could determine the "choice" between two[235] dramatically different future trajectories[236]. This is especially true when the system is unstable and subject to perturbations. The difference in controlling parameters may be small but the outcome effect is enormous[237]. Consider a system progressing through 10 bifurcation points, each with only two possible future paths. This results in 1 024 possible histories, the exact one that occurs being the result of chance events that determine a choice at each bifurcation point. After 20 bifurcations, the number of possibilities increase to 1 048 576 and after 50 to a staggering 1 125 899 906 842 624 (more than a qaudrillion[238]). This number is actually a minimum as there may be more than two possibilities to pursue at each bifurcation point.

- *Strange attractors.*[239] If a system's movement over time in an n-dimensional space is mapped, a system which was chaotic in the popular sense would be anywhere in that

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[232] Although not explicitly stated, this implies the existence of both positive and negative feedback loops.

[233] This highlights the impossibility of long-term prediction for non-linear systems, since the task of prediction would require knowledge of initial conditions of impossibly high accuracy. (Tsoukas, H. 2005. 218.)

[234] *Chaotic* is used in the technical sense as discussed earlier.

[235] Bifurcation implies a choice between two paths. Multifurcation may have been a better word, implying the possibility of multiple alternatives.

[236] Compare this with alternate histories mentioned above.

[237] The most frequently modeled real world example is provided by the world's climate system. It is clear from fossil and geological records that the world has experienced two climate regimes: the relatively warm one in which we live and an ice age. The transition from the one to the other is not a gradual linear process. It happens suddenly as a result of small scale perturbations in controlling variables. (Byrne, D. 1998. 23.)

[238] This is using American terminology, which differs from, for example, British or French. The size of this number is incomprehensible to the human brain. Consider that a quadrillion is much greater than the number representing the size of the visible universe in light years: 14 billion! A quadrillion seconds ago (more than 31 million years!) the first primates started appearing in Africa.

[239] There are also point attractors which lure systems to a stable state; and cycle attractors, which move systems into predictable but dynamic patterns. (Pascale, R, Millemann, M, Gioja, L, 2000. 70). Strange attractors are

space at successive time periods. However, a complex system's successive states would not be anywhere, but rather would be found within a restricted set within the range of possible positions. The system behaves as if attracted to a restricted pattern.[240]

- *Far from equilibrium.* Complex systems are dissipative, far from equilibrium and inherently evolutionary. External perturbations and spontaneous internal fluctuations cause the system to occasionally breach the system's boundaries, forcing it into a new and radically different trajectory, as happens at bifurcation points. Being static means death for a complex system.

Greybe[241] identified additional important attributes of complex systems:

- *Interaction.* A complex system involves a high number of interacting components, each interacting either directly or indirectly with many others based on local conditions. Complexity arises as a result of the dynamic interaction between components. Connectivity[242] between elements of the system is high.
- *Dynamic.* The system evolves over time.
- *Openness.* Open systems interact and communicate with their environment, exchanging nutrients, information and energy.
- *Self-organisation*. A complex system can return itself to overall stability after change, without any external help, by reorganising itself and adapting to external change as a new, evolved structure. The emergence of spontaneous order is self-organisation.[243]
- *Representation*. To self-evolve, complex systems must be able to acquire, store and later use information about the environment, i.e. it must represent important information.[244]

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of particular interest in the study of complexity. They are associated with states of "bounded instability" that oscillate paradoxically between stability and instability, far from equilibrium and at the "edge of chaos", utilising highly complex patterns of positive and negative feedback to produce diversity and novelty (Moss, M. 2001. 221).

[240] Bifurcation is the mechanism whereby a complex system switches from one attractor pattern to a different one.

[241] Greybe, S. 2004. 85-92.

[242] See also connectivity and interdependence as a characteristic of complex adaptive systems below.

[243] Joubert, C. 2005. 103.

[244] This is certainly true for complex adaptive systems (see discussion to follow), but doubtful for complex *non*-adaptive systems (like galaxies).

- *Autopoietic.* An autopoietic system is self-perpetuating (it maintains and renews itself), self-generating (it adapts to its environment and uses the environment's resources to its advantage) and self-bounding (it creates its own boundaries).

- *Feedback.* The results of a complex system's output are directly or indirectly fed back to be used as input again. These feedback loops may be positive (amplifying) or negative (balancing). Negative feedback tends to lead to stability and complex systems thus rely more on positive feedback to remain active.

- *Emergence.* Through the dynamic interaction between elements of the system, characteristics not inherent in the individual elements can emerge spontaneously. Emergent properties transcend the individual elements of a complex system in that their complexity cannot be understood by analysing the components in the system independently. Emergence is the appearance of a property or feature not exhibited previously through the process of interaction.[245]

Theorising about the emergence of order from complexity could lead to plausible explanations and the creation of new knowledge.[246]

Additionally, Tsoukas[247] underscores further properties of complex systems:

- Complex systems are fractal and thus scale-dependent. Accuracy of measurement depends on the measuring device. Measuring a coastline yields no single answer – it hinges on the scale chosen to measure it.

- Complex systems exhibit recursive symmetry between scale levels – they tend to repeat a basic structure at several levels. For example, turbulent flow can be modelled as small swirls nested within swirls nested within larger swirls.

MacLean and MacIntosh[248] describe complexity theory as being organised around a number of central concepts. A primary concern is with the emergence of order in complex adaptive

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[245] Joubert, C. 2005. 103.

[246] Often explanation for observed order eludes us, in which case an *empirical* or *phenomenological* theory is constructed to acknowledge the existence of a phenomenon without explaining it. Examples are Zipf's law, which states that the size of a ranked group is inversely proportional to its rank and the Pareto principle of wage distribution. These are examples of power laws, which have been observed regulating diverse phenomena, such as the number of sand grains in an avalanche to return the slope of a sand pile to its critical value and the frequency of the occurrence of earthquakes of differing intensities. (Gell-Mann, M. 1994. 92-100) Other examples of unexplained order in nature are the logarithmic spirals of the Nautilus (a cephalopod) shell, the arms of spiral galaxies, the arms of tropical cyclones and spider webs. Spirals constructed using Fibonacci numbers are a subset of logarithmic spirals.

[247] Tsoukas, H. 2005. 238.

systems existing far from equilibrium. Such order manifests itself through emergent self-organisation that occurs as a limited number of simple order-generating rules operating across a densely interconnected network of interacting elements to selectively amplify certain random events via positive feedback. This propels the system away from its current state towards a new ordered state in a way which is largely unpredictable.

Fuchs and Hofkircher[249] discussed two mechanisms of self-organisation, namely order from order and order from noise. Order from order manifests itself in a self-organising social system, which, in its self-reproductive phase, increases its level of order, new social structures emerge and the system expands. At a certain threshold, however, quantity turns into quality and the structures of the system fluctuate and enter a period of disorder. At this stage the order from noise principle comes into play: from the disorganised state new order emerges.[250]

3.3 Complex adaptive systems

The meaning of the term *organisation* has evolved over time.[251] The challenge of organising was felt by political units long before economic ones – nation states show significant organisational capacity – and *political* organisation was probably the first nuance associated with *organisation*. With the advent of the railway, telegraph and later the telephone, economic organisation emerged and organisations focused on transportation and distribution of physical goods. The emergence of the early 20th century modern corporation in the USA changed *organisation* to mean the organisation of production and planning and control processes were underpinned by a mechanical philosophy concerned with achieving efficiency. "Machine bureaucracies" worshipped their own god: Frederick Taylor. The efficient use of machines, coupled with information flows and feedback relationships opened the way for cybernetic concepts to be associated with *organisation* in the 1940s and 1950's, but managers still saw the organisation as a machine. During the 1960s and 1970s the open system perspective took root and *organisation* changed from machine to organism.

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[248] MacLean, D, MacIntosh, R. 2003. 150.

[249] Fuchs, C, Hofkircher, W. 2005. 243.

[250] This cycle of order from order and then order from noise could be likened to the behaviour of Boisot's SLC in the I-Space. Order from noise corresponds to the scanning and problem solving phases of the SLC where there is movement away from chaos into complexity and codification and abstraction increase towards the increasingly ordered regime. Order from order could be seen as the diffusion and partial movement towards the bottom of the I-Space where the threshold is reached and disorder reigns (Boisot's domain of chaos).

[251] The information in this paragraph is condensed from Boisot, M and Cohen J. 2000. 115-119.

Organisation theorists became increasingly uncomfortable with reconciling the "organisation-as-single-organism" model with the complexity they saw when looking inside organisations. The rapid growth of interorganisational networking, facilitated by the rise of the Internet, fostered the view that organisations are open systems looely coupled in interaction with others in an organisational ecology. In the late 20th century the focus shifted to issues of knowledge and the emergence of patterns and it became clear that organisations act more in a matrix of plausibilities than certainties. Seeing *organisation* as a complex adaptive system is well aligned with this perspective.

As this is an enquiry into the mechanisms whereby organisational knowledge is created and as organisations are composite complex adaptive systems consisting of humans who are also complex adaptive systems, a closer look at such systems are in order.[252] "Social and biological organizations are instances of complex objects, the outcome of dense interwoven processes unfolding over time".[253] A different way to look at organisation (but still in harmony with the definition developed earlier) is offered by McElroy: "Human organisations are … complex adaptive systems – that is, groups of independent, autonomous agents, all of whom share certain goals and operate in accordance with individually and collectively held rules"[254].

The phenomenon of gravitation gave rise, in the course of the physical evolution of the universe, to the clumping of matter into galaxies, stars and planets, all manifesting complexity, diversity and individuality (but are non-adaptive). The emergence of complex *adaptive* systems (which undergo processes like learning and evolution) elevated these properties to a new level of richness. On earth, the development of complex adaptive systems is associated with the origin of terrestrial life and the process of biological evolution which has produced a striking diversity of species. Complex adaptive systems function in diverse processes with certain common features: in each a complex adaptive system acquires information about its environment and its own interaction with that environment, identifies regularities in that information, condenses those regularities into a kind of "schema" or model and acts in the real world based on that schema. Various competing schemata are constructed

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[252] Contrary to the views of many others who see organisations as complex adaptive systems, Introna (Introna, L. 2003. 213-216) concludes that mathematical and physical sciences are ontologically incommensurate with social systems. Complexity theory can therefore only be used as metaphor or analogy in the social sciences, or used in a purely pragmatic way.

[253] Boisot, M, Cohen, J. 2000. 125.

[254] McElroy, M. 2000. 202.

and results in the real world feed back to influence the competition between those schemata.[255]

Mitleton-Kelly[256] discusses generic characteristics of complexity in terms of its relevance and appropriateness to a human system. She takes the approach that a deeper understanding needs the combination of several characteristics in the discussion:

- *Connectivity and interdependence.* Complex behaviour arises from the intricate inter-twining or inter-connectivity of elements within a system and between a system and its environment. In a human system, connectivity and interdependence means that a decision or action by any individual may affect related individuals or systems. Social, cultural, technical, economic and global dimensions may impinge upon and influence each other. Propagation of influence through a system depends on the degree of connectivity and interdependence. The degree of connectivity determines the network of relationships, the degree to which information and knowledge is transferred and is an essential element in the feedback process.

- *Co-evolution*. The evolution of a complex adaptive system changes the context of others to which it is connected, triggering reciprocal evolution. This co-evolution takes place within an ecosystem, which is the system plus its connected neighbours, but not in isolation. In a social co-evolving ecosystem, each organisation both influences and is influenced by the social ecosystem consisting of itself and all related businesses, organisations, consumers, suppliers, shareholders and other stakeholders, as well as the broader economic, cultural and legal contexts. No individual or organisation is powerless as each entity's actions reverberate through the web of inter-relationships[257] and affects the social ecosystem.

- *Dissipative structures, far-from-equilibrium and history*. Dissipative structures are ways in which open systems exchange energy, matter or information with their environment and which, when pushed far-from-equilibrium, create new structures and order. Under non-equilibrium conditions, entropy may produce, rather than degrade, order and organisation. Certain systems simultaneously evolve and grow more

[255] Gell-Mann, M. 1994. 16-17.

[256] Mitleton-Kelly, E. 2003. 26-43.

[257] This is reminiscent of Stafford Beer's approach to democratic decision making called Team Syntegrity, which is based on rich interconnections between participants in a non-hierachical, participative decision making system, where interconnections are structured based on an icosahedron. (Jackson, M. 2003. 233-251.)

coherent. In dissipative structures the tendency to split into alternative solutions is bifurcation. After bifurcation the system becomes a historical object in the sense that its subsequent evolution depends on the critical choice at the bifurcation point. In a social context, it is the series of critical decisions each individual takes from several possible alternatives that may determine a particular life path for that individual. At a bifurcation point, before choice or chance determines the preferent path, the alternatives are sources of innovation and diversification since the opening up of new possibilities endows the individual and the system with new solutions. When an organisation moves away from established work and behaviour patterns (equilibrium), new ways of working are created and new forms of organisation, which may be more robust and sustainable in competitive environments, may emerge.

- *Exploration of the space-of-possibilities*. Complexity suggests that to survive and thrive an entity needs to explore its space of possibilities and generate variety. The search for a single optimum strategy may be neither possible nor desirable. When conditions change a single selected strategy may no longer be optimal.[258] When searching the space of possibilities it is not possible to explore all possibilities. It may however be possible to explore change one step away from what already exists. Once discoveries have been realised in the current adjacent possible, a new adjacent possible becomes available.

- *Feedback*. Positive or reinforcing feedback drives change, while negative (balancing, moderating, dampening) feedback maintains stability in a system. In far-from-equilibrium conditions where non-linear relationships prevail, small inputs yield huge, startling effects which are likely to at least partly be the result of positive feedback. When a human system is disturbed and pushed to far-from-equilibrium conditions (e.g. a business after restructuring or a merger), it may reach a critical point and either degrade into disorder (loss of morale, loss of productivity, etc.) or create some new order and organisation. Positive feedback processes underlie such transformation and they provide a starting point for understanding the constant movement between change and stability in complex systems. Organisations are strikingly dominated by negative feedback mechanisms, like budgets, forecasts, progress reports, corrective action plans, etc., and there is a comparative lack of formal positive feedback

[258] When considering co-evolution, it becomes clear that execution of any strategy could change the environment to the extent that the strategy becomes ineffective.

mechanisms.[259] The interplay between positive and negative feedback loops could also be seen as an interaction between cooperation and competition.[260]

- *Self-organisation, emergence and the creation of new order*. These are three key characteristics of complex systems. Complex systems develop order spontaneously – this is called self-organisation. Emergent properties, qualities, patterns or structures arise from the interaction of individual elements; they are greater than the sum of the parts and may be difficult to predict by studying the individual elements. Emergence is the process that creates new order together with self-organisation. Emergence is related to the concept of the "whole" – i.e. a system needs to be studied as a complete and interacting whole rather than as an assembly of distinct and separate elements. In an organisational context, self-organisation may be described as the spontaneous coming together of a group for a purpose. The group decides what to do, how and when to do it and no one outside the group directs those activities[261]. Emergence in human systems tends to create irreversible structures or ideas, relationships and organisational forms, which become part of the history of individuals and institutions and in turn affect the evolution of those entities.

Although complex adaptive systems may differ widely in physical attributes, they resemble one another in the way they handle information.[262] A complex adaptive system can only function in conditions that are intermediate between order and disorder,[263] i.e. in the regime of complexity.

Computer technology makes it possible to simulate the behaviour of complex adaptive systems. The most striking feature of those simulations is the emergence of complex behaviour from simple rules.[264]

The figure below depicts a model of complex adaptive systems.[265] Knowledge is represented by the "rule system" As the system encounters incoming stimuli from its environment, it

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[259] MacLean, D, MacIntosh, R. 2003. 150.

[260] Baranger, M. 2001. 11.

[261] Such self-organisation in organisations is barely reconised by the formal power structures. Micro-political interaction may lead to the formation of coalitions around issues. A coalition may become influential and might result in significant loss in efficiency and effectiveness. (Flood, R. 1999. 117.)

[262] Gell-Mann, M. 1994. 21.

[263] Gell-Mann, M. 1994. 116.

[264] Gell-Mann, M. 1994. 313.

[265] This model was developed by the New England Complex Systems Institute.

fashions a response by invoking pertinent knowledge. Any actions taken produce effects internally and/or externally, the results of which are fed back into the system for immediate or future reference, refreshing knowledge in the process.

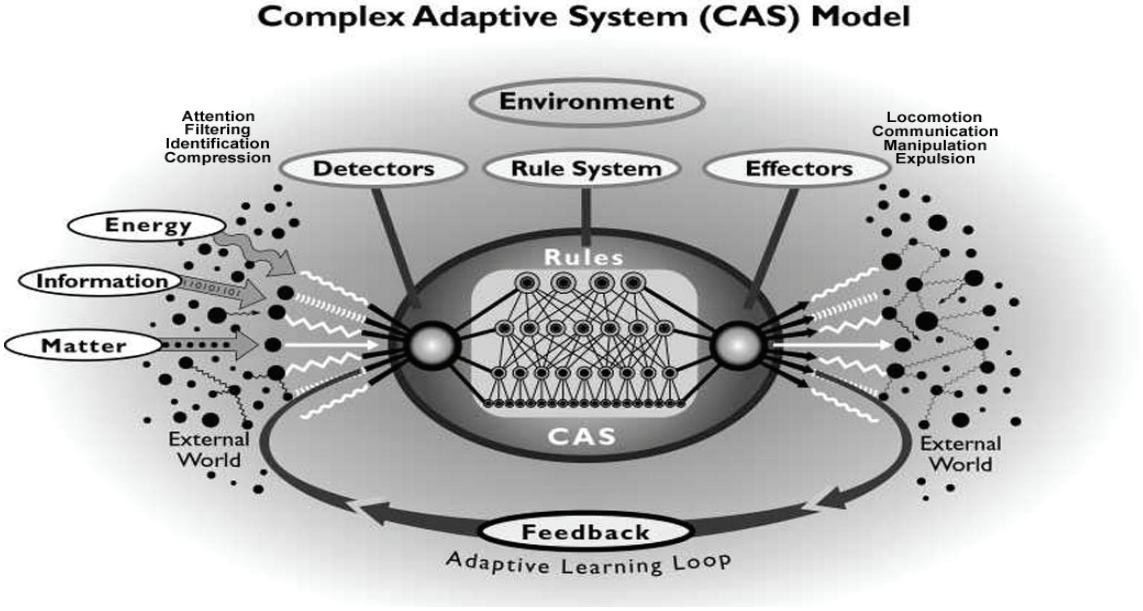

Figure 13. From McElroy, M. 2000. 197

Stacey[266] puts forward the following hypotheses about the properties of complex adaptive systems:

- Coherent global patterns of order will emerge from the spontaneous self-organisation of the agents[267] as they interact according to their local rules, all in the absence of any overall blueprint. The iterative, recursive, non-linear interactions constitute an attractor.
- The attractors may take a number of different dynamic forms depending on the states of important parameters, particularly the flow of energy, the number and strength of connections between agents and the degree of diversity of agents. This may result in stable or unstable random patterns.
- At critical ranges of the parameters, a dynamic between stability and randomness arises and this takes the form of attractors that are paradoxically stable and unstable at the same time. This happens at the edge of chaos.

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[266] Stacey, R. 2001. 71-72. These hypotheses are supported by the results of computer simulations of complex adaptive systems.

[267] In this context an agent is a set of rules that determines how that agent will interact with others on a local level.

- In the presence of random mutation and/or cross-over replication, the agents will evolve in an adaptive manner. In the presence of diversity, novel attractors will emerge. This evolution is radically unpredictable.
- At the edge of chaos attractors are stable because of redundant interactions, and are unstable because of the amplification of small differences (non-linearity). What happens at the edge of chaos is characterised by a power law: there are small numbers of large extinction events and large numbers of small extinction events. This provides stability in that large extinctions are rare, and also instability in that there are extinction events at all.

Finally, it should be stressed that the complexity of a system as interpreted by a human, is not an intrinsic property of the system: it is observer dependent.[268] Any definition of complexity is necessarily context-dependent and subjective – it depends on the description of one system by another system, presumably a complex adaptive system, which could be a human observer.[269]

From the perspective of complexity, organisations are complex adaptive systems that have to match the complexity of their environment to achieve an appropriate measure of fit or a degree of autonomy with respect to whatever constraints it might impose.[270]

3.4 Knowledge Creation at the Edge of Chaos

The study of complexity carries with it a point of view that facilitates the making of connections, sometimes between facts or ideas that at first glance seem very remote from each other.[271] This is exactly how the creation of new knowledge is facilitated by complexity. The very notion of a complex adaptive system that learns and evolves implies the creation of knowledge. Where there is complete order and regularity, there are no challenges. Where there is complete disorder and total randomness, total confusion reigns. The area in between where there is neither too much order nor too much disorder is the area where challenges are met. At the edge of chaos there is a paradoxical pattern of both stability and instability at the same time.[272] New knowledge more often arise in response to a challenge, rather than being

[268] Tsoukas, H. 2005. 236.
[269] Gell-Mann, M. 1994. 33.
[270] Boisot, M. and Child, J. 1999. 237.
[271] Gell-Mann, M. 1994. ix.
[272] Stacey, R. 2000. 29.

readily available when the challenge is presented.[273] A theorist creates new knowledge by identifying as much regularity as possible from a data stream being studied and then constructing hypotheses to explain the observed regularities.[274] This cannot happen in the chaotic regime where there are no regularities and neither in the ordered regime where it would be meaningless. It could only happen in the domain of complexity.

Although Nonaka's theory of organisational knowledge creation may be based on questionable foundations, he recognised the need for complexity to stimulate the creation of new knowledge. He discusses five enabling conditions for organisational knowledge creation[275], among them *fluctuation and creative chaos* and *requisite variety*. *Fluctuation* is not complete disorder and is order whose pattern is hard to predict at the beginning, in other words, exactly what is expected at the edge of chaos. "An environment of fluctuation often triggers a breakdown within the organization, out of which new knowledge can be created. Some have called this phenomenon creating 'order out of noise' or 'order out of chaos'."[276] *Creative chaos* is intentionally introduced chaos to stimulate the creation of new knowledge. *Requisite variety* is seen as another enabling condition for organisational knowledge creation. This effectively implies that the organisation should operate in the domain of complexity as insufficient requisite variety implies the chaotic regime and overabundant requisite variety implies the ordered regime.[277] These enabling conditions are in harmony with the idea that introducing a controlled level of "noise" into a situation might speed up the process of conceiving of a creative idea.[278] "… new knowledge is born in the midst of ambiguity and redundancy".[279]

Emergence of order through self-organisation could be seen as knowledge creation. The emergence of mental states, such as pattern recognition, feelings and thoughts may be explained by the evolution of order parameters of cerebral assemblies which are caused by non-linear interactions of neural cells in learning strategies far from thermal equilibrium.[280] Emergence in human systems tends to create ideas which become part of the individual's

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[273] Gell-Mann, M. 1994. 69.

[274] Gell-Mann, M. 1994. 105.

[275] Nonaka, I, Takeuchi, H. 1995. 73-83.

[276] Nonaka, I, Takeuchi, H. 1995. 79.

[277] See the discussion of the Ashby Space above.

[278] Gell-Mann, M. 1994. 267.

[279] Nonaka, I, Takeuchi, H. 1995. 12.

[280] Mitleton-Kelly, E. 2003. 41. Interpretation of work by Varela and Mainzer.

history and in turn affect its evolution. For example: the emergence of knowledge and innovative ideas when a team is working together could be described as an emergent property – it arises from the interaction of individuals and could be something quite new and possibly unexpected. These new ideas and knowledge can be built upon to create further ideas and knowledge.[281] Clearly then, complex adaptive systems create new knowledge as a result of being in the complex regime, or put differently: humans (and organisations) become creative at the edge of chaos.

Stacey[282] regards the process of interaction between complex adaptive agents as central in new knowledge production. Human relating intrinsically patterns living human experience as the coherence of continuity and transformation, which is knowledge emerging without any global blueprint. Specifically, conversational relating between people is the process in which knowledge perpetually emerges. "The very process of self-organizing interaction, when sufficiently richly connected, has the inherent capacity to spontaneously produce coherent pattern in itself, without any blueprint or program. Furthermore, when the interacting entities are different enough from each other, that capacity is one of spontaneously producing *novel* patterns in itself."[283] (Emphasis added). This new knowledge, also seen as an emerging new attractor, occurs only at the edge of chaos.

Rooney et al[284] suggests that knowledge is the result of the process of knowing, which is an "evolving and variable constellation of the conceptual, intellectual, cognitive, intuitive, emotional, spiritual, axiological and motor bases to achievement that is an *emergent property of relations*, and that is regarded as a reliable basis for action" (emphasis added).

Kuscu[285] refers explicitly to *organisational* knowledge as the *emergent* property of interactions among knowledge relevant entities of an organisation. Planned knowledge creation activities are futile. An organisation is at its most creative and innovative when it operates at the edge of chaos. This is endorsed by Fuchs and Hofkircher when they state that *societal* knowledge *emerges* between active human agents who participate in a self-organising social system.[286]

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[281] Mitleton-Kelly, E. 2003. 42.

[282] Stacey, R. 2000.

[283] Stacey, R. 2000. 35.

[284] Rooney, D, Hearn, G, Mandeville, T, Joseph, R. 2003. 16.

[285] Kuscu, I. 2001. 117, 118.

[286] Fuchs, C, Hofkircher, W. 2005. 246.

Boisot states that knowledge in the I-Space region of maximum value and minimum entropy is always subject to increasing entropy through the forces of diffusion and destructuring, eroding whatever value has been created.[287] This is nothing less than a movement from the ordered regime to the edge of chaos where new knowledge is created again.

It also now becomes clear that an alternative way of looking at organisational knowledge would be to see it as the justification for the organisational capacity to act which emerges as a result of the complex interaction of its members. This again emphasises that organisational knowledge is in the first place situated in the individual, but that the unique organisational context allows the connectedness and interrelationships to facilitate *organisational* knowledge creation.

3.5 Waypoint #2

Entropy, seen as ignorance, offers a clue as to how new knowledge comes into being. New knowledge, seen as emerging order, is the reduction of entropy.[288] Emergence is the antithesis of entropy.[289] The link between complexity and the creation of new knowledge is clear in the light of McKelvey's assertion that complexity science is fundamentally aimed at explaining order creation.[290]

Boisot's SLC has been interpreted as a framework for organisational knowledge creation in the previous chapter. In this chapter the link between the lower regions of I-Space where the SLC moves through its scanning phase generating new knowledge and complexity has also been demonstrated. Specifically, the scanning phase of the SLC, which starts in the area where chaos and complexity meet, involves the finding of patterns in fuzzy data and results in unique, idiosyncratic insights. Scanning, in other words, is where new knowledge is generated at the edge of chaos, reducing entropy and increasing order as a result of the emergence of the new knowledge and causing a movement along the SLC away from the region of chaos. If we accept that the world is complex and non-linear, we must conclude that

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[287] Boisot, M. 1995. 189.

[288] The second law of thermodynamics implies that spontaneous evolution of an isolated system can never lead to a decrease of its entropy, which always increases as long as the system evolves. If the system reaches equilibrium and stops evolving, its entropy becomes constant, meaning that an isolated system cannot acquire more knowledge without help from the outside. The paradox between the second law of thermodynamics and decreasing entropy can be explained using chaos theory. The surprising conclusion to the reconciliation is that entropy (which is also a measure of our lack of knowledge) is a purely subjective quantity! (Baranger, M. 2001. 12-17.)

[289] Boisot, M, Cohen, J. 2000. 125.

[290] McKelvey, B. 2003. 99.

for the most part, it occupies the lower regions of the I-Space[291] where opportunity for new knowledge creation is bountiful.

Aspects of complexity were discussed above, not exhaustively, but sufficient ground was covered to show that new knowledge arises out of complexity. Organisations are in constant flux out of which the potential for the emergence of novel practises is never exhausted.[292] One question now remains: what is the process whereby new knowledge emerges out of complexity? This is the territory the next phase of the journey traverses.

[291] Boisot, M. 1998. 100.

[292] Tsoukas, H. 2005. 111.

Chapter 4
Sensemaking as Knowledge Creation

4.1 Why sensemaking?

This chapter will argue that sensemaking generates knowledge. Sensemaking in a literal sense can be defined as "meaning making" or "feeling making", reflecting both the cognitive and emotional aspects of human interaction with environments.[293] The occasions for sensemaking, i.e. ambiguity, uncertainty, interruption and arousal, are typically found at the edge of chaos and will be discussed below. This is exactly where new knowledge is created in Boisot's I-Space. The contention here is that the knowledge creation at the edge of chaos takes place in organisations through the process of sensemaking. The relationship between organisational knowledge creation, complexity and sensemaking is hinted at in Tsoukas' view of the task of management: "Management can be seen as an open-ended process of coordinating purposeful individuals, whose actions stem from applying their partly unique interpretations to the local circumstances confronting them. Those actions give rise to often unintended and ambiguous circumstances, the meaning of which is open to further interpretations and further actions, and so on. Given the distributed character of organizational knowledge, the key to achieving coordinated action does not so much depend on those 'higher up' collecting more and more knowledge, as on those lower down finding more and more ways of getting connected and interrelating the knowledge each one has".[294]

But what is sensemaking? The basic idea of sensemaking is that reality is an ongoing accomplishment that emerges from efforts to create order and make retrospective sense of what occurs.[295] Sensemaking provides meaning. Bhatt[296] declares that it is only through meaning that information finds life and becomes knowledge. Sensemaking occurs when an expectation is disconfirmed and meaning is ascribed to an event, grounded in both individual and social activity.[297] Sensemaking is not interpretation, but interpretation is a component of

[293] Schwandt, D. 2005. 182.
[294] Tsoukas, H. 2005. 111-112.
[295] Weick, K. 2001. 106.
[296] Bhatt, G. 2000. 89.
[297] Weick, K. 1995. 5,6.

sensemaking. Interpretation gives meaning to something already there, but sensemaking is about both interpretation and authoring, discovery as well as creation.[298] Sensemaking suggests the construction of that which then becomes sensible.[299] Although modern researchers include creativity, comprehension, curiosity, mental modelling and situational awareness as factors or phenomena involved with or related to sensemaking, it is more: it is a motivated, continuous effort to understand connections (which can be among people, places and events) in order to anticipate their trajectories and act effectively.[300]

Weick[301] explains sensemaking by analogy to cartography: there is a terrain that mapmakers want to represent and they use various modes of projection to make the representation. What they actually map depends on where they look, how they look, what they want to represent and their tools for representation. There is no "One Best Map" of a particular terrain – there will be an indefinite number of useful maps. It is the job of the sense maker to convert a world of experience into an intelligible world, not to look for the one true picture that corresponds to a pre-existing, preformed reality. The picture of sensemaking that emerges is that we are trying to make our experience and our world as comprehensible to ourselves in the best way we can and that the order we come up with is a product of our imagination and need, not something dictated by "reality".

Sensemaking generates understanding that is provisional, plausible, subject to revision, swift, directed towards continuation of interrupted activity, tentative, infused with ignorance and sufficient for current purposes. It starts out as a momentary, expedient understanding, but the sense thus created often lingers and gets stored as if it were the product of a far more deliberate, intentional analysis.[302] This is how new knowledge (*knowledge* as defined earlier) comes into being.

Situations that trigger sensemaking are filled with cues in need of some frame to organise them. There is also an imperative to act. Sensemaking is about assessing a situation while simultaneously taking action that affects what you are busy discovering. It is difficult to separate object and subject in sensemaking. Sensemaking involves the continuous retrospective development of plausible images that rationalise what people are doing. It

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[298] Weick, K. 1995. 8.
[299] Weick, K. 1995. 14.
[300] Klein, G et al. 2006a. 71.
[301] Weick, K. 2001. 9.
[302] Weick, K. 2001 96.

focuses on a limited set of cues and then elaborates those few cues into a plausible, pragmatic, momentarily useful guide for actions that themselves are partially defining the guide that they follow.[303] The essence of sensemaking lies in focusing on cues from an environment and finding a relationship between those cues and a mental framework built from prior experience and sensemaking: a cue in a frame is what makes sense. The frame could be reconciled with knowledge as defined earlier.

It seems that sensemaking involves the creation of knowledge. In order to arrive at a clear link between knowledge creation, complexity and sensemaking, the latter will be investigated to the extent necessary to demonstrate that sensemaking provides the final component to explain organisational knowledge creation at the edge of chaos.

4.2 Seven Properties of Sensemaking

Having looked in a general way at what sensemaking is and implies, it is necessary to delve somewhat deeper to gain sufficient understanding to underscore the fact that sensemaking is also a knowledge creation process. For that, we first turn to the seven properties of sensemaking identified by Weick that distinguishes it from processes such as understanding, interpretation and attribution.[304] Sensemaking is a process that is:

- Grounded in identity construction;
- Retrospective;
- Enactive of sensible environments;
- Social;
- Ongoing;
- Focused on and by extracted cues;
- Driven by plausibility rather than accuracy.

Each of these properties will be elaborated upon below.

Grounded in identity construction: No individual ever acts as an isolated sense maker. Identities are constituted out of the process of interaction. Each different interaction brings forth a different identity. There is one identity among colleagues, another when surrounded

[303] Weick, K. 2001. 460.

[304] Unless otherwise indicated, this section is based on Weick, K. 1995. 17-62.

by family, yet another when interacting with friends at a sporting event. Any sense maker is undergoing continual redefinition by deciding which self is appropriate to project in any specific interaction.[305] At the same time a person's definition of the world around him will also change depending on his self-definition – the situation defines the self, and the self-identity defines the situation. The establishment and maintenance of identity is a core preoccupation in sensemaking.

Furthermore, individuals' self-concepts and personal identities are shaped in part by how they believe others view the organisation for which they work, implying that individuals would be personally motivated to preserve a positive organisational image.

Sensemaking begins with a self-conscious sense maker and derives from the need within individuals to have a sense of identity. When identity is lost, a person's grasp of what is happening begins to loosen. Intentional sensemaking is triggered by a failure to confirm one's self and occurs to maintain a consistent positive self-conception. People learn about their own identities by projecting them into an environment and then observing the consequences. They then react to the environment, but at the same time try to shape it.

"The more selves I have access to, the more meanings I should be able to extract and impose in any situation. Furthermore, the more selves I have access to, the less the likelihood that I will ever find myself surprised or astonished,[306] although I may find myself confused by the overabundance of possibilities and therefore forced to deal with equivocality".[307]

"When identity is threatened or diffused, as when one loses a job without warning, one's grasp of what is happening begins to loosen."[308]

Retrospective: The world we perceive is in reality a historical one. As soon as any intellectualisation takes place, the instant that we perceive has already occurred, even if only microseconds ago. Things are seen before they are conceptualised.[309] People can know what

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[305] Identity is how we see ourselves. Image is how others see us. There is danger when sensemaking fails to provide us with an appropriate identity and we continue to cling to one which is inappropriate for the circumstances. (Drummond, H. 2001. 235-237.)

[306] This is yet another manifestation of Ashby's law of requisite variety, which Weick restated as "if you want to make sense of a complex world, you've got to have an internal system that is equally complex" (Weick interview with John Geirland published in Wired, April 1996).

[307] Weick, K. 1995. 24.

[308] Weick, K. 2001. 461.

[309] It takes a finite amount of time, perhaps as much as one-tenth of a second, for visual images to be transmitted from the eye, along the optic nerve, to the brain. One literally sees into the past, although images are interpreted as being in the present.

they are doing only after they have done it. It is only possible to direct attention to that which has already passed. We are only conscious of our sensory processes, which means that we become conscious of motor processes only through sensory processes which are their resultants – our actions are always a bit ahead of us.

This means that to create meaning, one needs to direct attention to what has already occurred. Anything in the past is subject to memory, implying that anything affecting memory will also influence the sense that is made of those memories. The notion of a stimulus evoking a response could be misleading, as an action can only become the object of attention after it has occurred, by which time several possible causes could be plausible. The choice of stimulus affects the meaning of the action, both influenced by the situational context.

All knowledge, all meaning, all insight and all understanding come from looking backward.[310] The danger in this is that knowing the outcome of a complex history makes people view that history as being much more determinant, leading inevitably to the outcome they already know.[311]

Sensemaking is influenced by what people notice in elapsed events, how far back they look and how well they remember what they were doing.[312] Each of us is aware that we look back to events and find explanations and meaning for past events, which may change in time to suit our changed circumstances or related understanding. We often rationalise the meaning of elapsed events to suit current situations. "We act and then invent a reason for acting."[313]

"When people refuse to appreciate the past and instead use it casually, and when they put their faith in anticipation rather than resilience, then their acts of retrospect are shallow, misleading and halfhearted, and their grasp of what is happening begins to loosen."[314]

Enactive of sensible environments: Not only do people find meaning in retrospect, but they actively create environments which give comfort because they find them sensible. Interpretation explains how people cope with entities that already exist, but sensemaking also

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[310] Drummond, H. 2001. 37.

[311] The link to deterministic chaos is clear: explaining the outcome of a history which is the result of random choices at multiple bifurcation points is unproblematic and may lead to a false sense of causality. Retrospective explanation of an outcome in a chaotic system is possible – see section 3.2.

[312] Weick, K. 2001. 462.

[313] Drummond, H. 2001. 46.

[314] Weick, K. 2001. 462.

explains how those entities got there in the first place. Especially in organisational life people often produce part of the environment they face.

There is an ongoing codetermination between people and their environments during sensemaking: people enact sensible environments which influence them and trigger further enactment in a never ending process. People create their environments as those environments create them. This again questions the notions of stimulus-response or cause-effect, which should rather be seen as moments in a process of codetermination, as events related to each other.

The world that people create becomes the environment that constrains their actions and orientations. Among a group of people organisation can be enacted as a world that makes sense. They enact an environment that in turn enacts their organisational identity. Conventional perspectives depict organisations as responding to threats and opportunities in the environment, but another possibility is that organisation members create that environment in their own heads and then act as if their creation is forcing them to – which it eventually does.[315]

Action is used to gauge what one is up against. We ask questions, make declarations to elicit responses or probe to see a reaction. Having intervened like this we will never be sure what might have happened if we had not acted – in a sense the situation is now partially what we enacted. Action generates feedback, it is a form of reality testing.[316] To stay passive will not improve one's grasp of a situation because much of what a situation means lies in how it responds. "When probing actions are precluded, or avoided, or unduly narrow, it becomes difficult to grasp what one might be facing."[317]

Social: Our conduct is shaped by the conduct of others, regardless whether those others are actually physically present, absent or only imagined. Sensemaking is never solitary because what a person does internally is contingent on others. The social character of sensemaking does not necessarily imply common values or shared meaning in a group or organisation, but it does imply alignment and workable relations. Meaning comes from social interaction and takes both its coherence and contradictions from its social basis.[318]

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[315] Drummond, H. 2001. 66.

[316] Drummond, H. 2001. 262.

[317] Weick, K. 2001. 463.

[318] March, J. 1994. 210.

"Sensible meanings tend to be those for which there is social support, consensual validation and shared relevance. … When social anchors disappear and one feels isolated from social reality of some sort, one's grasp of what is happening begins to loosen."[319]

Ongoing: Pure duration flows incessantly and the only way in which people can make sense of something is to pluck a piece out of the continuous flow, place boundaries around it to transform it into a discrete event, direct attention to it and extract cues from it. There are no starting points and no ending points: people are always in the middle of things. The experience of sensemaking is one in which people are thrown into the middle of things and forced to act without the benefit of a stable sense of what is happening.[320]

The flow sometimes gets interrupted and this invariably induces an emotional response that influences sensemaking – sensemaking is infused with feeling. Interruption of the normal flow leads to arousal and people try to construct some link between the present situation and a relevant prior situation to make sense of the arousal. People remember events that have the same emotional tone as what they currently feel and those previous events might suggest the meaning of present events. Past events are reconstructed in the present as explanations because they feel the same.

Focused on and by extracted cues: Sensemaking is about the imaginative way in which people elaborate tiny indicators into full-blown stories that selectively support an initial instinct. Extracted cues are simple, familiar structures that are seeds from which people develop a larger sense of what may be occurring. A specific observation becomes linked with the more general form or idea in the interests of sensemaking, which then clarifies the meaning of the particular, which then alters slightly the meaning of the general, and so on.

Context affects what is extracted as a cue and also how that cue is then interpreted. Cues become reference points for sensemaking and stimulate a cognitive structure that leads people to act, creating a material order in the place of a presumed order. Presumed order becomes tangible order when faith in a cue leads to enactment. Sensemaking tends to confirm the faith in extracted cues through its effects on actions that make material that which previously had merely been envisioned.

"… both individual preferences for certain cues as well as environmental conditions that make certain cues figural and salient affect one's sense of what is up. When cues become

[319] Weick, K. 2001. 461.

[320] Weick, K. 2001. 462.

equivocal, contradictory, or unstable, either because individual preferences are changing, or because situations are dynamic, people begin to lose their grasp of what is happening."[321]

Weick suggests that cues are selectively extracted from the ongoing flow, biased by prior knowledge, resulting in only noticing cues that tend to confirm a prior plausible view rather than those cues that disconfirm. There is, however, recent research showing the opposite.[322]

Driven by plausibility rather than accuracy: Sensemaking is about coherence and credibility. It is about plausibility, pragmatics, reasonableness, creation, invention and instrumentality.

Accuracy is secondary for a variety of reasons. Firstly, people distort and filter the present in order not to be overwhelmed with data. Secondly, sensemaking embellishes upon a single extracted cue which may have multiple meanings and significance. It is more crucial to get some interpretation to start with, rather than to wait for the most accurate interpretation. Sensemaking is also retrospective, relating to the past, but the past is a reconstruction and never occurred exactly as remembered. Accuracy is meaningless when used to describe a filtered presence with an edited reconstruction of the past. Thirdly, speed often reduces the need for accuracy when a quick response could shape events before an accurate meaning is apparent. Fourthly, in a rapidly changing ongoing stream of activity, accuracy which is focused on specific questions in a limited context for a brief period is the most one can hope for. Fifthly, the interpersonal quality of organisation suggests that plausibility rather than objective accuracy should be the norm. Sixthly, people find sense in those things they can do something about. What is believed as a consequence of action is what makes sense – accuracy is not the issue in sensemaking. The seventh reason why plausibility rather than accuracy is important in sensemaking is that people who act tend to simplify rather than elaborate. Biased extraction of cues may be bad for deliberation, but is good for action. In a changing, malleable world, confident, bold and enthusiastic action, even if based on positive illusion, can be adaptive. The final reason is that it is impossible to tell at the time of perception whether that perception is accurate or not.

"Sensemaking is not about truth and getting it right. Instead, it is about continued redrafting of an emerging story so that it becomes more comprehensive, incorporates more of the observed data, and is more resilient in the face of criticism".[323]

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[321] Weick, K. 2001. 462.

[322] Klein, G et al. 2006b. 90.

[323] Weick, K. et al. 2005. 415.

March argues that social exchange leads an organisation towards internally shared understanding as idiosyncratic individual interpretations are changed by exposure to interpretations of more conventional others, resulting in the organisation to move towards a reliable, but not necessarily valid, interpretation.[324]

The seven properties of sensemaking can be "crudely represented as a sequence (people concerned with *identity* in the *context of others* engage *ongoing* events from which they extract *cues* and make *plausible* sense *retrospectively*, all while *enacting* more or less order into those ongoing events)".[325]

People tend to find stories plausible when they tap into an ongoing sense of current climate, are consistent with other data, facilitate ongoing projects, reduce equivocality, provide an aura of accuracy and offer a potentially exciting future.[326]

For Weick, sensemaking has the following features:[327]

i. Active agents place stimuli in a framework so that they can comprehend, explain, attribute, extrapolate and predict.

ii. Individuals form conscious and unconscious anticipations and assumptions as predictions of what they expect to encounter. Sensemaking is triggered when there is a discrepancy between such expectations and what they encounter. The need for explanation is triggered by surprise and takes the form of retrospective accounts to explain those surprises. Meaning is ascribed retrospectively as an output of a sensemaking process and does not arise concurrently with the detection of the difference.

iii. Sensemaking is the process people employ to cope with interruptions of ongoing activity.

iv. It is a process of reciprocal interaction of information seeking and meaning ascription, that is, it includes environmental scanning, interpretation and associated responses.

v. There is a distinction between generic (collective) and intersubjective (individual relating) forms of sensemaking.

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[324] March, J. 1994. 210.

[325] Weick, K. 1995. 18.

[326] Mills, J. 2003. 169-173.

[327] Stacey, R. 2001. 36-37.

In summary it could be said that sensemaking continuously supports the construction of appropriate identities in a social setting (and partially the construction of that setting) based on cues which are retrospectively processed in a plausible manner. Sensemaking plays a central role in the determination of human behaviour.[328]

4.3 Occasions for Sensemaking

What stimulates the process of sensemaking? What concerns this study is specifically the organisational context. The discussion to follow is therefore specifically focused on occasions for sensemaking in organisations.[329]

There are two types of interruptions that trigger sensemaking: (i) an event that is not expected, and (ii) an expected event that does not happen. The work of a number of researchers suggests that people are shocked into attention and then initiate novel action. These shocks interrupt an ongoing flow and are repaired gradually and plausibly. Two types of "shocks" are common in organisations, namely ambiguity and uncertainty. In the case of ambiguity people engage in sensemaking because they are confused by too many interpretations, but in the case of uncertainty they do so because they are ignorant of any interpretation.

Ambiguity: The shock that interrupts the flow in the case of ambiguity is confusion. Ambiguity in this case means an ongoing stream that supports several different interpretations at the same time. Events are judged to be ambiguous if those events seem to be unclear, highly complex or paradoxical.[330] Ambiguity is subjectively perceived, interpreted and felt. Ambiguity does not mean a lack of understanding that will be remedied by more information. The existence of multiple meanings attracts attention and initiates a sensemaking process.

When ambiguity is present, people who can resolve it gain power, as do their visions of the organisation. Ambiguity becomes the occasion when ideology may be shuffled. Continuous

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[328] Weick, K, Sutcliffe, K, Obstfeld, D. 2005. 409.

[329] Unless otherwise indicated, this section is based on Weick, K. 1995. 83-105.

[330] Weick argues that the term equivocal be used to signify the presence of multiple interpretations as a trigger to sensemaking, as ambiguity might be taken to mean a lack of clarity which could be confused with uncertainty.

ambiguity exerts pressure on organisations to modify their structure so that coping is more successful.[331]

Ambiguity is when alternatives are hazily defined or have multiple meanings. Information may not resolve misunderstandings as the "real" world may itself be a product of social construction[332] and is not so much discovered as invented.[333]

In organisational life ambiguity is rife. The table below suggests some ways, many undoubtedly recognisable, in which ambiguity may crop up in organisational life.[334]

Table 1. Characteristics of Ambiguous, Changing Situations

Characteristic	*Description and Comments*
Nature of problem is itself in question	"What the problem is" is unclear and shifting. Managers have only vague or competing definitions of the problem. Often, any one "problem" is intertwined with other messy problems.
Information (amount and reliability) is problematical	Because the definition of the problem is in doubt, collecting and categorizing information becomes a problem. The information flow threatens either to become overwhelming or to be seriously insufficient. Data may be incomplete and of dubious reliability.
Multiple, conflicting interpretations	For those data that do exist, players develop multiple and sometimes conflicting interpretations. The facts and their significance can be read several different ways.
Different value orientations, political/emotional clashes	Without objective criteria, players rely more on personal and/or professional values to make sense of the situation. The clash of different values often politically and emotionally charges the situation.
Goals are unclear, or multiple and conflicting	Managers do not enjoy the guidance of clearly defined, coherent goals. Either the goals are vague, or they are clearly

[331] Weick, K. 2001. 47.

[332] See the discussion on *enactment* above.

[333] March, J. 1994. 179.

[334] Weick, K. 1995. 93, reprinted from McCaskey, M. 1992. *The Executive Challenge: Managing Change and Ambiguity.* Marshfield, MA: Pitman.

	defined and contradictory.
Time, money, or attention are lacking	A difficult situation is made chaotic by severe shortages of one or more of these items.
Contradictions and paradoxes appear	Situation has seemingly inconsistent features, relationships or demands.
Roles are vague, responsibilities are unclear	Players do not have a clearly defined set of activities they are expected to perform. On important issues, the locus of decision making and other responsibilities is vague or in dispute.
Success measures are lacking	People are unsure what success in resolving the situation would mean, and/or they have no way of assessing the degree to which they have been successful.
Poor understanding of cause-effect relationships	Players do not understand what causes what in the situation. Even if sure of the effects they desire, they are uncertain how to obtain them.
Symbols and metaphors used	In place of precise definitions or logical arguments, players use symbols or metaphors to express their points of view.
Participation in decision-making fluid	Who the key decision makers and influence holders are changes as players enter and leave the decision arena.

Ambiguity in organisations is not limited to what is asserted in the table above. Organisations frequently have ambiguous preferences and identities, ambiguous experiences and history, and ambiguous technology: they are loosely coupled.[335] One of the central tenets of organisations is decision making. Ambiguity is a central feature of decision making – both the world and the self are ambiguous.[336] Ambiguity as a trigger for sensemaking is especially relevant as ambiguity is omnipresent, or, in Drummond's words: "Ambiguity always lurks."[337]

[335] March, J. 1994. 193.

[336] March, J. 1994. 218.

[337] Drummond, H. 2001. 6, 69, 209.

Uncertainty: The shock that interrupts an ongoing flow and initiates sensemaking in the case of uncertainty is ignorance. Uncertainty[338] has been defined in various ways, but the common thread among these definitions is the insufficiency of information. March sees uncertainty as imprecision in estimates of future consequences conditional on present actions.[339] Tsoukas points out that although organisational theory emphasises that uncertainty is the absence of relevant information, there is another type of uncertainty, namely having information which is puzzling.[340]

Weick emphasises that the shock occasioned by an inability to extrapolate current actions and to foresee their consequences produces an occasion for sensemaking.

The difference between ignorance and confusion: To remove ignorance, more information is required. To remove confusion, a better quality of information is required, like the additional and more varied cues available in rich interpersonal encounters such as direct contact and meetings. The sensemaking process may lead to the enactment of what is needed to resolve ignorance or confusion. People mistakenly try to reduce their confusion with formal information processing that is not rich enough, or their ignorance with a group meeting that is too rich. Either mismatch can prolong and intensify what started out simply as something out of the ordinary.

4.4 Sensemaking in Organisations

The link between individual sensemaking and the organisation is clear when one considers that organisations shape individual action both by providing the content of identities and by providing appropriate cues for invoking them.[341] The importance of decision making in organisations has been emphasised by many,[342] but sensemaking, rather than decision making, may be the more central organisational issue.[343] Weick views organisations as collections of people trying to make sense of what is happening around them.[344]

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[338] An intriguing standpoint is that uncertainty evokes emotion, which is nothing other than a type of knowledge. This emotion-knowledge is directed towards entities that threaten progress towards objectives, i.e. entities that interrupt the normal flow (Nussbaum, M. 2001).

[339] March, J. 1994. 178.

[340] Tsoukas, H. 2005. 285.

[341] March, J. 1994. 71.

[342] Morgan, G. 1997. 392, 178; Chapman, S. 2003. 362.

[343] Weick, K. 2001. 4.

[344] Weick, K. 2001. 5.

What then are the differences between everyday sensemaking and organisational sensemaking?[345] There are several overlapping areas, but also some discontinuities. A description of sensemaking in an organisational setting might be "when people in an *ongoing social* setting experience an interruption, they often *enact* something, *retrospectively* notice meaningful *cues* in what they previously enacted, interpret and retain meaningful versions of what the cues mean for their individual and collective *identity*, and apply or alter these *plausible* meanings in subsequent enactment and retrospective noticing"[346] (emphases in the original). Dougherty et al sees organisational sensemaking as the social processes of developing a common or shared understanding essential for innovation, a process that draws on new or unfamiliar knowledge.[347]

It is worth noting that what is plausible to one group, such as managers, may be totally implausible for another, such as employees,[348] which suggests that power relations may influence sensemaking in organisations. This is acknowledged by Marshall and Rollinson who see disruptions not only as a stimulus for sensemaking as a process of collective understanding, but also as impetus for detailed strategies and counterstrategies in attempts to privilege certain meanings over others through their association with alternatively constituted forms of power.[349]

Weick concludes that organisations that are more open to their environment should be more concerned with sensemaking as they have more diverse information to deal with. Such organisations have to handle boundary judgements, and decisions about what is external to the organisation and what is internal are the focus of sensemaking, resulting in inventions rather than discoveries. Openness to the environment is a source of ambiguity and triggers the sequence in which outputs become the occasion to retrospectively define what could have been plausible inputs and processes.

Sensemaking occurs on four levels, starting with the *individual*, where meaning is constructed within the individual. At the macro level there are three additional levels of sensemaking at progressively higher planes compared to individual sensemaking: intersubjective, generic subjective and extrasubjective.

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[345] Unless otherwise indicated, this section is based on Weick, K. 1994. 63-82.

[346] Weick, K. 2001. 95.

[347] Dougherty, D. et al. 2000. 323.

[348] Weick, K. et al. 2005. 415.

[349] Marshall, N, Rollonson, J. 2004. S73.

Intersubjective meaning emerges when individual thoughts, feelings and intentions are merged or synthesised into joint meaning; when "I" becomes "we". A merged subject is created and meaning emerges not only within the individual, but among selves.

Generic subjectivity is the level where intersubjectivity acquires social structure. Concrete human beings are no longer present as subjects, but are replaced by the social structure. Individuals become replaceable and interchangeable and meaning is embedded in the role to be filled.

The *extrasubjective* is at the level of culture where social structure is replaced by pure meaning, totally divorced from the individual, such as the symbolic realities of capitalism or mathematics.

Organisations are the *bridges* between the *intersubjective and the generically subjective*, at the point where "we" acquire social structure. This view leads to issues that illustrate when and where organisational sensemaking takes place. Sensemaking in an organisation:

i. is needed to coordinate action in a world of multiple realities;

ii. generates vivid, unique, intersubjective understandings that can be picked up and enlarged by people who did not participate in the original construction, thereby accomplishing (i) above;

iii. allows renegotiation of the loss of understanding that occurs when the intersubjective is translated to the generically subjective;

iv. facilitates managing the tension inherent in the transition between the innovation inherent in intersubjectivity and the control inherent in generic subjectivity;

v. occurs in a setting where reconciliation is accomplished by interlocking routines and habituated action patterns generated by dyadic interaction;

vi. creates and maintains equivalent understandings around issues of common interest for organisation members through continuous communication activity, shaping the patterned activity which is the basis of a social organisation.

Organisations experience strong pressure to move toward generic sensemaking because of the need for rapid socialisation, control over resources, legitimacy, measurable outcomes and accountability. Generic subjectivity creates controlling structures where people can substitute

for one another and which reassures people that if they don't look too closely, the world makes sense and things are under control.[350]

The importance of a specific organisational context to sensemaking was underlined in a study of sensemaking in futures trading operations by Levin.[351] The sensemaking process resulted in essentially two different prices, one determined by open outcry and the other by electronic trading, two vastly differing organisational environments. He concludes that markets are not the self-regulating mechanisms of resource allocation of economic theory, but depend fundamentally on sensemaking situated in an ongoing cultural and organisational edifice.

4.5 Sensemaking and Knowledge creation

Learning is the process of acquiring knowledge, which might be existing knowledge transferred from one individual to another, or totally new knowledge which is created. Learning is inexorably entwined with the understanding processes that help define sensemaking.[352] Sensemaking is the key conduit for understanding both individual and organisational learning.[353] Knowledge is always subject to sensemaking mechanisms: it has to make sense to be fully understood and used.[354]

Recall the definition of knowledge developed earlier: *Knowledge is the expectations, modifiable by perceived information, residing in the human brain, allowing plausible interpretations of the environment and used in determining appropriate action.* This knowledge is the product of sensemaking, as is quite clear from the following: "… we expect to find explicit efforts at sensemaking whenever the current state of the world is perceived to be different from the expected state of the world. … When the situation feels 'different', this circumstance is experienced as a situation of discrepancy, breakdown, surprise, disconfirmation, opportunity or interruption. Diverse as these situations may seem, they share the properties that in every case an expectation of continuity is breached, ongoing organized collective action becomes disorganized, efforts are made to construct a plausible sense of what is happening, and this sense of plausibility normalizes the breach, restores the expectation and enables projects to continue".[355] This means that sensemaking starts when

[350] Weick, K. 1995. 170.
[351] Levin, P. 2005.
[352] Thomas, J et al. 2001. 332.
[353] Thomas, J et al. 2001. 343.
[354] Styhre, A et al. 2002.
[355] Weick, K. et al. 2005. 414-415.

knowledge is lacking or insufficient to deal with a situation, progresses with the creation of new knowledge and ends with the ability to handle the "different" situation, which importantly is not only associated with the negative connotations of discrepancy, breakdown, disconfirmation and interruption, but also with the positive nuances of opportunity.

Nisbett and Ross[356] found that the individual frequently develops rudimentary knowledge by *resolving ambiguity*. Resolving ambiguity is a sensemaking process, i.e. sensemaking produces new knowledge. A study by Thomas, Sussman and Henderson supports this by concluding that sensemaking is an important conduit for both individual and organisational learning.[357]

Weick argues that interruptions are common occasions for instigating sensemaking,[358] but interruptions have also been found to facilitate team knowledge acquisition in a study by Zellmer-Bruhn.[359] "The 'pause' created by an interruption may be enough for the team to notice new knowledge and acquire it, even without deliberate search effort." Although the study was not concerned with the method whereby new knowledge was acquired, it is higly likely that the interruptions initiated sensemaking that resulted in new knowledge.

March[360] alludes to the link between ambiguity and knowledge creation as follows: " … ambiguity may be used to augment understanding through imagination. … Ambiguous worlds are disturbing, but they are also magical. Beauty and ugliness are compounded; reality and fantasy are intertwined; history is created; intelligence is expanded". An ambiguous world triggers sensemaking (the use of *imagination*), there may be enactment (the interwtining of reality and *fantasy*), it is retrospective (*history* is created) and it results in new knowledge (*intelligence* is expanded).

A parallel with sensemaking as knowledge creation can be found in Bruner and Anglin's statement that "a person actively constructs knowledge … by relating incoming information to a previously acquired psychological frame of reference".[361] Sensemaking is about making the connection between a frame and a cue[362] and although the terminology differs, clearly

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[356] Nisbett, R, Ross, L. 1980.
[357] Thomas, J, Sussman, S, Henderson, J. 2001. 343.
[358] Weick, K. 1995. 86.
[359] Zellmer-Bruhn, M. 2003. 524.
[360] March, J. 1994. 179.
[361] Bruner, J, Anglin, J. 1973. 397.
[362] Weick, K. 1995. 110.

Bruner and Anglin are referring to the same process. Interpreting the work of several authors, Von Krogh et al reason that organisational knowledge evolves and changes as organisational members reach agreement on interpretations of their individual and shared common experiences,[363] again a clear reference to organisational sensemaking on a generically subjective level.

Further evidence that sensemaking is a knowledge creation activity is found in an empirical case study examining narrative based processes of sensemaking and knowledge acquisition conducted by Patriotta at the Mirafiori pressing plant at Fiat Auto, Italy.[364] The study was carried out on the shop floor "in order to observe how knowledge is empirically produced 'in action'. Our 'descent to the shop floor' was an attempt to gain hands-on experience of empirical knowledge-related phenomena associated with real actors, concrete problems, and everyday organizational practices."[365] It was found that disruptive events like breakdowns, interruptions, and technological perturbations that interrupted routine business-as-usual situations triggered sensemaking in the shape of problem solving activities. While solutions are still pending, operators are faced with equivocality. The situation becomes socially constructed through a network of conversations between members of the team on the shop floor. Eventually, solutions are elaborated, mostly drawing on a repertoire of past similar cases, but sometimes *creating new knowledge*, and sooner or later the problem is solved.[366]

Joubert[367] argues that sensemaking is the construction of knowledge of oneself and the world in the sense that it is the process of rearranging our understanding of experience so that we can know what has happened, what is happening and can predict what will happen – a sense totally compatible with the definition of knowledge used here. Also congruent with this definition is the view of Klein et al that sensemaking results in the anticipation of trajectories.[368]

The above clearly shows that sensemaking, which is triggered by people not being able to understand a situation, results in new knowledge being created, which is used to resolve the gap in understanding that existed before.

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[363] Von Krogh et al. 1994. 62.
[364] Patriotta, G. 2003.
[365] Patriotta, G. 2003. 371.
[366] Patriotta, G. 2003. 369.
[367] Joubert, C. 2005. 20, 27.
[368] Klein, G et al. 2006a. 71.

4.6 Waypoint #3

This chapter has shown that sensemaking results in new knowledge. Recall the definition of organisational knowledge developed in chapter 2:

Organisational knowledge is the aggregate of both the distributed and common knowledge held by individual members of the organisation, applied in the organisational context, the application of which is shaped and guided by power relations and the unique idiosyncratic organisational context and history in which it is utilised.

Organisations supply the unique social context where sensemaking results in knowledge of both the common and distributed varieties generated and this knowledge fulfils the requirements of the definition of organisational knowledge.

Boisot's SLC cycles through regions where entropy is low and order is high, through a region of complexity to a region of chaos, where entropy is high and ambiguity and uncertainty abounds. It is here that sensemaking is stimulated, resulting in increased order and a movement along the SLC back towards the ordered domain.

The expedition's destination is in sight.

Chapter 5
Synthesis

5.1 Taking Stock

Being able to show that sensemaking in organisations is the mechanism whereby organisations create new knowledge when confronted by complexity, would validate the hypothesis postulated in chapter 1. In previous chapters the concepts of knowledge and organisational knowledge were delineated and some theories of organisational knowledge creation were discussed, with Boisot's Social Learning Cycle chosen as archetype. It was shown that complexity is a catalyst for knowledge creation and that sensemaking is a knowledge creation process. The three key elements in the argument, *organisational knowledge*, *complexity* and *sensemaking* were examined and the association between organisational knowledge *creation* and complexity, as well as the relationship between organisational knowledge creation and sensemaking were clarified. Although the final connection in the triangle, namely the relationship between sensemaking and complexity was addressed in the previous chapter, in what follows below, the implications of those points are further elaborated. Finally, this chapter reinterprets the Social Learning Cycle by incorporating all the waypoints reached thus far, and offers the new-look Social Learning Cycle as the final synthesis.

5.2 Sensemaking and Complexity

There are many ways in which sensemaking and complexity are associated. Not only does sensemaking start with chaos,[369] but chaos also provides the perfect example of the importance of retrospect for sensemaking. The outcome of deterministic chaos is impossible to predict, but unproblematic to explain in retrospect as part of the sensemaking process. "Once a person knows the outcome, the reasons for that outcome seem obvious and the person cannot imagine any other outcome".[370,371]

The process of enactment whereby sensible environments are created is nothing less than a feedback loop: the sense maker influences his world which in turn influences him, either

[369] Weick, K et al. 2005. 411.

[370] Weick, K. 2001. 37.

[371] This is hindsight bias which leads to the predictability of events being overestimated.

directly or indirectly. This is especially pronounced in an organisational setting where enactment by a single sense maker will reverberate throughout the organisation, influencing other organisational members who, through their own acts of sensemaking, will in turn provide further input to the original sense maker in a complex web of *organisational* feedback loops. Interestingly, enactment could have unanticipated consequences[372] leading to increased complexity, ambiguity or uncertainty, initiating further sensemaking.

One way of looking at sensemaking is to see it as the process of imposing order upon complexity. The seven properties of sensemaking can be "crudely[373] represented as a sequence (people concerned with identity in the context of others engage ongoing events from which they extract cues and make plausible sense retrospectively, all while *enacting more or less order into those ongoing events*)".[374] (Emphasis added). The *enactment* of order manifests itself as the process of *organising*. Organisation and the process of sensemaking both attempt to impose order on ongoing flows in organisations and should not be seen as two processes, but as a single process. "… people make collectively sense in terms of the sensemaking processes and organise, in terms of the same processes, to make collectively sense."[375] Sensemaking *is* imposing order upon complexity.

Complexity sciences *explain* but do not *predict* (emphases in the original),[376] which is exactly what sensemaking does by explaining retrospectively in a plausible, but not necessarily accurate, manner.

An unmistakable link between sensemaking, complexity and knowledge creation can be found in Maturana and Varela's[377] description of knowledge as the result of *emergent* processes of knowing through *sensemaking* dependent on *complex* historical contexts. This view perfectly supports the argument that new knowledge emerges as the product of sensemaking initiated by complexity. This same linkage is pointed out by Connor[378] when he reasons that organisations create new knowledge when faced by confusing elements in unfamiliar situations (i.e. *complexity/ambiguity*) by assigning meaning to data (i.e.

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[372] Weick, K. 2001. 176.

[373] Weick describes the sequence as *crude* because feedback loops (among others) are omitted.

[374] Weick, K. 1995. 18.

[375] Joubert, C. 2005. 17, 18.

[376] Boisot, M, Cohen, J. 2000. 132.

[377] Maturana, H, Varela, F. 1992.

[378] Conner, D. 1998. 20.

sensemaking) and applying the resulting information successfully (i.e. more sensemaking in the form of *enactment*).

5.3 The Social Learning Cycle Revisited

The notion that knowledge resides only in the human brain precludes the possibility of the codification of such knowledge. The codification dimension of the I-Space needs to be addressed in order to accommodate this view of knowledge. The codification dimension is also a measure of complexity[379] with maximum complexity corresponding to minimum codification in the lower regions of the I-Space. As this study is only interested in the creation of knowledge, the codification dimension becomes irrelevant to the extent that the hypothesis being investigated confines itself to the complex region at the edge of chaos low in the I-Space. It is however useful to interpret the I-Space in a slightly different way, in order to achieve as much harmony with Boisot's conception as possible, by replacing the codification dimension with a knowledge-information-data continuum. This substitution resonates with Boisot's original in that it follows the complexity scaling of the codification axis which equates less codification with greater complexity and vice versa. On the modified axis the data end of the scale is at the top, corresponding to minimum complexity; the knowledge end of the scale is at the bottom, corresponding to greater complexity; with information in between. The modified I-Space is shown below:

[379] Boisot, M. 1998. 46. The codification scale is the algorithmic information complexity of a data processing task.

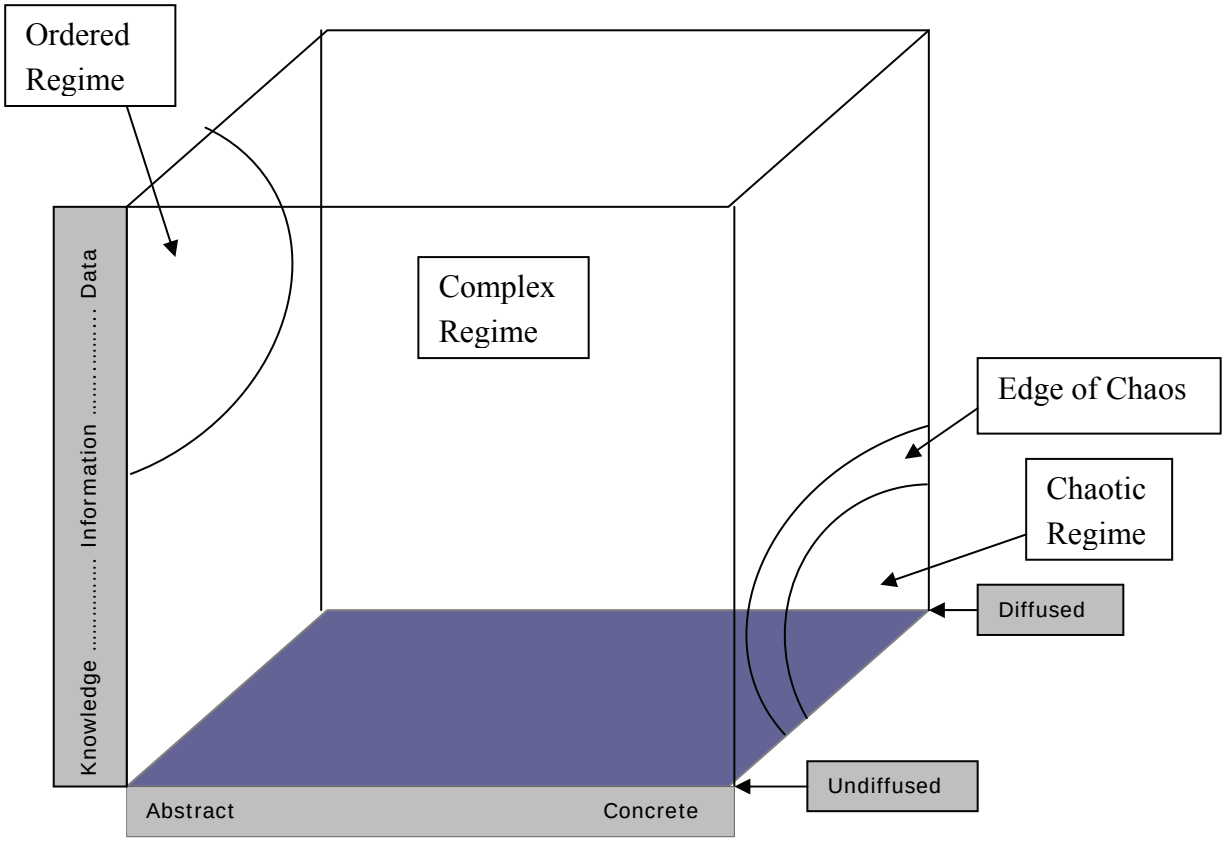

Figure 14. Modified I-Space

In this modified I-Space the lower region is inhabited by knowledge, while information and data respectively is found at progressively higher regions. It is also useful to interpret the area immediately adjacent to the chaotic regime as the edge of chaos. There is of course no sharply delineated border between order and complexity, complexity and the edge of chaos, and the edge of chaos and the chaotic regime itself; one should rather view these areas as adjacent with one gradually blending into the other.

The modified I-Space is conceptually still valid as a model for data, information and knowledge flows in an organisation. Although one dimension of the space was relabelled, the new label could equally well have been superimposed on the old, changing none of Boisot's arguments. The relabelling is convenient for the purposes of this argument as it focuses the attention on the scanning phase of the SLC which takes place in the lower region. Any move upwards along the original codification dimension now implies a conversion of knowledge into information and later into data, both of which are only peripheral to the main thrust of the argument. The modified I-Space accommodates the concept of knowledge developed in 2.2 above which holds that knowledge cannot exist external to the human brain. The SLC can now be seen as describing knowledge flows in the lower regions of the I-Space while the

higher regions typify flows of information and data. The SLC in the modified I-Space would then appear as in the figure below.

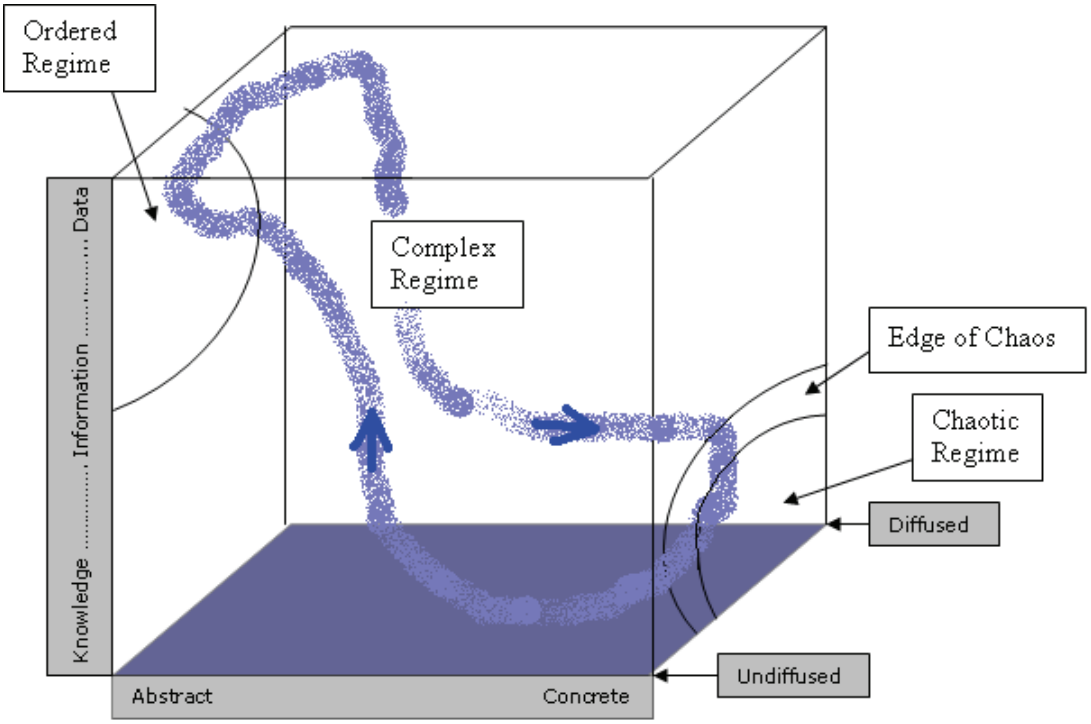

Figure 15. The SLC in the modified I-Space

Although not indicated, it should be noted that during scanning (and other phases) data external to the population in the I-Space may enter to influence development.[380]

Boisot illustrates the scanning phase of the SLC in the *lower* region of I-Space, i.e. moving from the edge of chaos to the region where uncodified, idiosyncratic knowledge exists, with examples drawn from the circumstances surrounding the attack on Pearl Harbour and the Cuban missile crisis.[381] Both crises could have been forestalled if detected early enough. In both cases sufficient data was already available to the American intelligence community, but the data was circumstantial and *ambiguous*. Reasonable men could differ as to its meaning and time was needed to cast it into a pattern whose *plausibility* could command enough *consensus* among senior intelligence officers. These examples of scanning clearly show elements of organisational sensemaking: (i) a crisis interrupts ongoing projects; (ii) ambiguity abounds; (iii) the interruption and ambiguity of data triggers sensemaking; (iv) this should result in a plausible pattern; (v) the plausible pattern would provide a retrospective

[380] Boisot, M. 1998. 62.

[381] Boisot, M. 1995. 182-183.

interpretation or construction, explaining (by then) historical data; (vi) the organisational quality of the sensemaking is hinted at by the requirement of consensus; (vii) the consensus among senior officers is an allusion to the social character of the process. The result of this sensemaking process is of course the new knowledge that will dictate the action to be taken.

In his elucidation of the scanning phase of the SLC,[382] Boisot points to a number of sensemaking elements. The similarities between Boisot's explanation of scanning and Weick's views on sensemaking are summarised in the table below:

Boisot on the scanning phase of the SLC	**Weick on sensemaking**
External stimuli assail us every waking moment, generating a stream of hypotheses. Events flow past us.	We find ourselves in a continuous flow.
Only stimuli that violate expectations carry information and with it new knowledge. Anomalous stimuli low and to the right in I-Space (i.e. at the edge of chaos) trigger the scanning process.	Sensemaking starts with the interruption of a flow.
"Perceptual recklessness" masks important signals and focuses the "data processing agent" on others signals deemed to be important.	Sensemaking is focused *on* extracted cues.
Hypotheses generated by stimuli act as barriers to the recognition of incongruous stimuli.	Sensemaking is focused *by* extracted cues.
Scanning results in suitable responses being devised in the time allowed by circumstances between signal detection and what follows from it.	Sensemaking is retrospective.
Personal and social validation shape our convictions and our sense of what is real.	Sensemaking is social.

[382] Boisot, M. 1995. 191-195.

Scanning in the lower part of I-Space is fraught with problems as signals are ambiguous.	Ambiguity (too many interpretations) is an occasion for sensemaking.
Scanning occurs where signals are weak.	Uncertainty (ignorance of interpretations) is an occasion for sensemaking.

An omnipresent assertion in Boisot's writings about the SLC is that the scanning phase creates *new* knowledge in the form of unique or idiocratic insights that become the possession of individuals or small groups. The lower region of I-Space is where learning strategies come to terms with non-linearity and creative potential can be exploited.[383] From the table above, and informed by the previous chapters, a clear picture emerges: the SLC scanning phase *is* the process of sensemaking. The process whereby organisational knowledge is created can now be depicted by the following sequence:

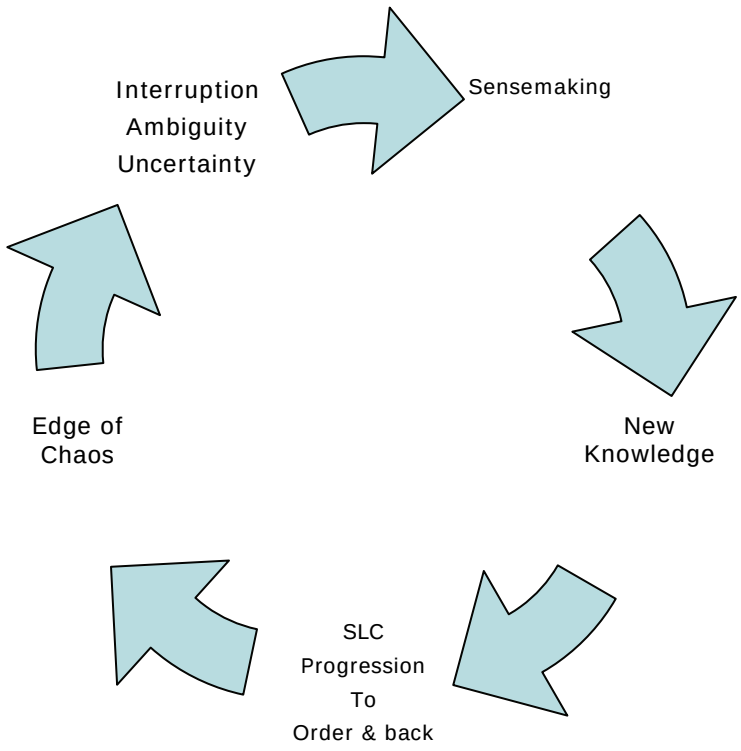

Figure 16. The organisational knowledge creation process

The cyclical flow of the SLC can now be redescribed as follows: In the lower region of I-Space at the edge of chaos normal flows are interrupted and ambiguity and uncertainty exists

[383] Boisot, M. 1998. 99.

in a disordered environment. This results in sensemaking through which *new* knowledge *emerges* in a movement along the SLC from the edge of chaos to the less diffused region of I-Space where this new knowledge is available to fewer people. From this point on, the SLC moves through its normal progression to the ordered regime, from where increasing entropy naturally drives movement back to the edge of chaos,[384] where the cycle starts afresh.

5.4 Implications

The foregoing has shown that at the edge of chaos, organisational sensemaking *is* organisational knowledge creation. The obvious implication is that when an organisation finds itself stagnating, or in a position of misalignment with its environment, the deliberate introduction of complexity and the subsequent encouragement of sensemaking processes could lead to the generation of new knowledge needed to get out of the rut.

Nonaka and Takeuchi encourages the introduction of "fluctuation and creative chaos" in organisations to trigger the creation of new knowledge. This could be accomplished by management setting challenging goals or introducing an ambiguous vision or philosophy. They warn, however, that the benefits of creative chaos can only be realised when organisational members have the ability to reflect upon their actions, without which the creative chaos might turn into destructive chaos.[385] In the light this study, the *reflection* they refer to seems to be *sensemaking* which generates the knowledge needed to return to a more orderly state.

The added value of this study lies in the insight that the introduction of complexity (or creative chaos) should be followed by organisational sensemaking processes to generate new insights and knowledge, failing which the organisation might fall into real and destructive chaos.

Managers' perception of reality should acknowledge that reality is not static and linear, but complex, dynamic and non-linear, and as such unpredictable.[386] This change in outlook could be accomplished by appropriate training and education, for example by using a tool such as the Complexity Starter Kit.[387]

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[384] Boisot, M. 1998. 67.

[385] Nonaka, I, Takeuchi, H. 1995. 78-80.

[386] Harkema, S. 2003.

[387] Webb, C, Lettice, F, Lemon, M. 2006.

When an organisation has been delicately manoeuvred to the edge of chaos, sensemaking processes is what prevents the chaos from becoming destructive. These processes could be facilitated by a knowledgeable individual using meetings, intranets, informal talks, and whatever other means they have, to initiate either belief driven processes of sensemaking (arguing, expecting) or action driven processes (committing, manipulating). "Sensemaking is an effort to tie beliefs and actions more closely together as when arguments lead to a consensus on action, clarified expectations lead the way for confirming actions, committed actions uncover acceptable justifications for their occurrence, or bold actions simplify the world and make it clearer what is going on and what it means."[388]

Looking back, we have seen how the Social Learning Cycle can be a model that links knowledge creation and the context of chaos and complexity. It has been argued that those features of the world that put a premium on organisations' knowledge creation abilities, are primarily found in the lower regions of the I-Space and that it is exactly there where opportunity for knowledge creation also abounds. Organisational sensemaking processes are instrumental in imposing order and this corresponds with the movement along the Social Learning Cycle back towards the ordered domain. Reinterpreting the I-Space slightly, highlights the role of the context of complexity in knowledge creation and it shows that organisational sensemaking is not a process that *precedes* organisational knowledge creation, but is so integrally part of that process that it is more properly seen as the very process by which new knowledge is created. This extends both the application of organisational sensemaking theory and reinterprets the Social Learning Cycle.

[388] Weick, K. 1995. 135.

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