An Adaptive Approach to Organisational Knowledge Management

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Abstract

This paper presents a case for an adaptive view of organisational knowledge and suggestions for its computational implementation. Organisations and their environments are dynamic and the knowledge created and required by them is subject to rapid change. The creation, dissemination and utilisation of knowledge may be analysed using the principles of complex adaptive systems (CAS). It is suggested that organisational knowledge shows properties of an organic living entity which continuously exploits facts and information and reflects an adaptive understanding and experience of conducting business. Based on the principles of CAS, a set of basic properties of organisational knowledge is presented. The paper also introduces a computational model to explore knowledge dynamics within intranets using these properties.

Introduction

Advances in the field of knowledge management raise important concerns about the diverse approaches to the nature of organisational knowledge. These approaches range from purely commercial to philosophical-social [1][2][3][4][5]) and scientific views including information systems, autopoiesis [6][7][8], complex adaptive systems [7][9][10] and artificial intelligence [11]. What is it that constitutes the knowledge of organisations? Gourlay [12] reviews various definitions of knowledge falling into three main frameworks: the empiricist, the rationalist, and the cultural or socio-historic frameworks. Tsoukas [5] broadly groups approaches to organisational knowledge into two categories: those who seek to classify types of organisational knowledge and those who seek to understand organisational knowledge based on analogies between organisations and human brains or individual minds.

A typical taxonomy of knowledge falling into the first category imitates managerial activities or functional structure of the organisations. This approach, for example, proposes a hierarchical view where knowledge is built upon raw business data and information that is used for middle or higher level decision making. This is a static view of structured or semi-structured transactions data or other forms of explicit content such as financial analysis information, documents, e-mails, etc.

Another well-known example of this category is the differentiation of explicit and tacit knowledge [13][4].

Although simplistic, this approach identifies some *knowledge gaps* within an organisation. An organisation may easily identify which *explicit* knowledge it has and which it does not have. However, in the case of *tacit knowledge* (i.e., ideas, values, intuition, best practices, etc.) organisations may not be fully aware if they possess certain tacit knowledge or not. Although approaches to classification of knowledge are useful in providing taxonomies which can easily be understood, they often provide a static and generalised view of organisational knowledge. They also suffer from an incomplete account of how knowledge is created.

The research of the second category focuses on similarities between organisations and how the human mind works. According to this research, knowledge is richly connected and is distributed within organisations. It is suggested that most of the knowledge exists in the people, processes, products and structure of the organisations. The creation of knowledge as the collective efforts of the individual minds in a distributed manner makes an organisation robust in reaching goals and targets. However, this does not explain how individuals construct their actions and how the distributed nature of the knowledge comes about [5].

Research falling into either of these categories provides an incomplete account of organisational knowledge. One of the important factors influencing the behaviour of organisations is the nature and level of change occurring either within or outside them. With fast technological advances, the influence of change on organisations becomes more and more critical. Any account of organisational knowledge must have a special emphasis on how knowledge gets created and disseminated under constant pressures from the changing knowledge requirements for conducting successful business.

A recent effort from "new knowledge management thinkers" integrates principles of complex adaptive systems, organisational learning and knowledge management [10]. This research builds on a model of the knowledge life cycle [14] describing a process where knowledge is produced through learning, gets validated, and then converted into useful forms. The key in this life cycle is the complex adaptive systems view of how knowledge is formed at the level of individual learning and how it becomes collectively shared at the organisational level. This is one of the first views expressing organisational knowledge creation and dissemination as a dynamic, ever-changing process.

Similar to ideas developed by the new KM thinkers, this paper presents an account of organisational knowledge, which is adaptive to changes in the organisation and its environment. It starts with attempting to unify the perspectives of various approaches on knowledge by presenting knowledge creation as an adaptive intelligent activity. It then argues that organisational knowledge is an emergent property of continuous interactions among the knowledge relevant entities of an organisation. After providing a brief discussion on organisational knowledge and its properties using the principles of complex adaptive systems, it is claimed that a good understanding of organisational knowledge and its dynamics can be achieved through use of computational techniques such as artificial life and evolutionary computation [15]. The paper concludes by introducing an example application and summary of the important points raised.

Organisational Knowledge and Intelligence

It is often simple and intuitively plausible to view knowledge as the next natural extension of a data-information-knowledge. However, while there is a reasonable degree of understanding and agreement regarding how information may be derived from data, the connection from data and information to knowledge does not seem to be as clear (See Figure One). This connection may be explained in various ways depending on one's perspectives - whether it is from philosophy, sociology, linguistics, cognitive science and artificial intelligence, learning, ecology, dynamical systems or complex adaptive systems. Is there a comprehensive approach to explaining and managing knowledge?

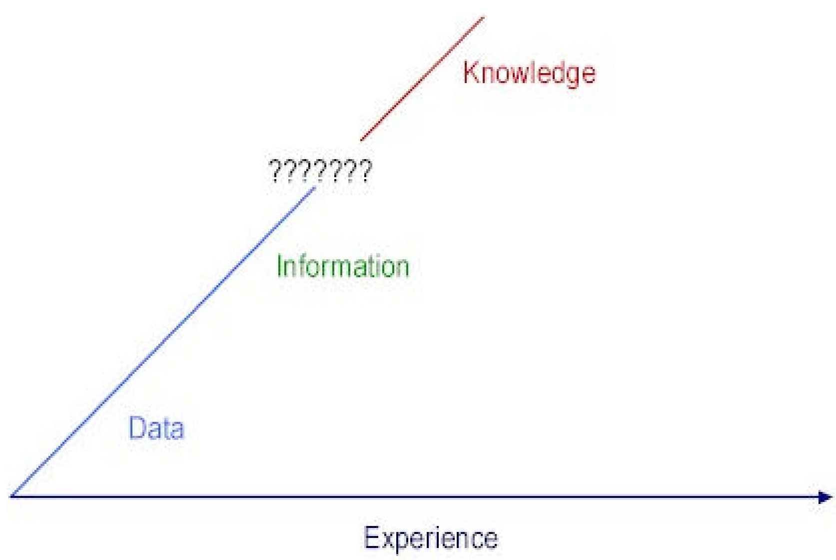

Figure One -- Data/Information/Knowledge (Dis)Continuum

Keeping this question in mind, let us look at the connection between information and knowledge in somewhat more detail. The dictionary definition of knowledge refers to "familiarity gained by experience", "theoretical or practical understanding (of subject, language etc)" and "range of information" [16]. These definitions exhibit an important property of knowledge. Creation of knowledge requires *intelligence*. Forming a body of information, understanding and gaining experience are all intelligent activities. The transformation of data to knowledge requires intelligence, which we do not know much about. It is, therefore, no surprise that there are various perspectives on the nature and utility of knowledge stemming from various attempts to explain knowledge as a product of intelligent behaviour. Current scientific knowledge is not able to provide a comprehensive answer to what knowledge is because we simply do not know, sufficiently, the nature of intelligent activity which takes place when knowledge gets created. Will we ever be able understand intelligence and how knowledge is created so that we can come up with sound approaches to managing knowledge?

During the last half decade or so studies in cognitive science and artificial intelligence have concentrated on understanding human intelligence and simulating it in artificial environments such as computer simulations or robots. Earlier research in artificial intelligence (AI) concentrated on designing intelligence using an engineering approach. Intelligence, in this sense, was in the mind of the designer. The systems built using this approach would only be as intelligent as their designs, which were typically limited by the designer's concept of intelligence.

Although this work resulted in discovery of some useful methods and techniques in simulating artificial intelligence, its contribution to our understanding of intelligence and to building intelligent systems was limited. The influential factors limiting the progress of earlier AI achievements include the attempt to simulate the most complex form of intelligence –(the human intelligence) and the ambition that human intelligence could be understood by adopting a holistic view and a top-down design approach.. This earlier AI research, which is mainly based on symbolic computation, is now frequently called Good Old-Fashioned Artificial Intelligence (GOFAI) [17]

The new efforts in understanding intelligence propose a more pragmatic approach to studying it often called the NEWAI [18]. Since there are various forms of intelligence in nature, most of which are much less complicated than human intelligence, a good strategy for the study of intelligence is to attempt to understand these simpler forms of intelligence first, and eventually try to scale up to human intelligence. For example, insect behaviours such as foraging, obstacle avoidance and pursuit may be easier to understand and simulate than human intelligence.

Building systems showing these simple behaviours may help us to gain insights into intelligence in its simpler and more manageable forms. The techniques of evolutionary computation (the most recent coverage and advances in the area can be found in [15]) such as genetic algorithms [19] [20] are powerful search methods. These techniques are simple imitations of natural evolution where a population of solutions is refined through a number of iterations using one or more operators such as selection, crossover and mutation. Evolutionary computation is successfully applied to developing evolutionary and adaptive systems that show life-like behaviours. [21][18]

The NEWAI approach also proposes that intelligence may not be understood sufficiently if it is not considered as a "situated" concept [18]. In this sense intelligence is an *emergent* property of actions for survival within a changing world. It comes into existence through *adaptation* to a changing environment. This research, as part of complex adaptive systems research, is often called artificial-life (or a-life)) and borrows various methods and approaches from dynamical systems, evolutionary biology, chemistry and ecology. Using evolutionary and co-evolutionary methods, a-life scientists attempt to simulate intelligent behaviour without pre-conceived ideas about the technical design aspects of intelligence.

For example, in order to solve a problem using if-then rules, GOFAI would advocate a careful design of rules, often extracted from domain experts. NEWAI would favour use of an evolutionary computation method to automatically discover such rules using iterative and stochastic search methods (e.g., genetic algorithms) Similarly, while earlier AI researchers have simulated the brain using hand-designed artificial neural networks, NEWAI would evolve the topology of these networks to automatically optimise the number of nodes and the connections among them with minimal human designer input.. In this way NEWAI promotes ways of discovering properties of intelligence not only as *we-know-it* but also as *it-could-be*.

According to NEWAI, knowledge creation is not a discrete or an incremental process moving from data to information and then to knowledge. Nor can one make a clear distinctive analysis of knowledge in terms of the explicit and tacit distinction. Knowledge is an embodied concept reflected through organisational dynamics. Knowledge gets created as an adaptive response to knowledge requirements of internal and external business pressures. Therefore, it seems that methods of NEWAI may better help us in discovering the secrets of knowledge and its creation as an intelligent activity than the older GOFAI methods..

Organisational Knowledge

The account of organisational knowledge falling into either of Tsoukas' [5] categories follows a route similar to the way GOFAI considered intelligence for half a decade. This way of looking at intelligence failed to provide an adequate account of it. Rigorous efforts such as engineering technological infra-structures for data and information management, development of knowledge databases and the use of collaborative technologies can only offer limited capabilities in understanding, capturing and disseminating organisational knowledge. Conscious efforts to form knowledge centres, intellectual capital teams or groups for sharing best practices fall short as well.

Our capabilities of building knowledge infrastructures with pre-conceived ideas about organisational knowledge may at best help us to identify systematic ways of codifying knowledge that *we know we have* and importing knowledge that *we know we don't have*. In this way, either new data or information is transferred into the organisation or some form of transformation operation is conducted using the existing data and information. The problem with this approach is that any knowledge solution offered will be static and specifically engineered for the problem at hand. However, in fast changing and competitive environments, the assessment of appropriate tools and techniques for transforming, storing and disseminating knowledge and the kind of knowledge needed may all be subject to changes in the business requirements and environmental influences. Furthermore, in a dynamically changing business environment, the knowledge most needed is the knowledge that then must be converted into effective actions to respond to dynamic business requirements. It also may well be the knowledge that an organisation *does not know it does* or *does not have*.

NEWAI suggests a different approach to what constitutes organisational knowledge. It suggests that the transformation from data and information to knowledge cannot be understood in isolation. These instances of transformation occur as part of organisational dynamics that exerts behaviour similar to that of complex adaptive systems.

Organisations, when viewed as complex adaptive systems consider many entities - individuals, data, information, processes, structures, culture and so on - as involved in the creation of organisational knowledge. These entities are strongly linked to and influenced by each other and the environment of the organisation. They continuously interact with each other and the environment.

In this interaction, while some of the entities may sometimes be passive, some others try to accomplish certain localised tasks through collaboration or competition, obeying some simple rules defining their behaviours. Organisational knowledge is the emergent property of this interaction. It is an organic living entity. It contains individual knowledge as well as knowledge embodied in processes or structures, but it is completely separate from these.

Organisational knowledge is the ever-changing *understanding* and *experience* gained through conducting business. It maintains its existence through a continuous exploitation of facts and their subjective interpretations (i.e, information). It cannot be conceptualised as a whole and it is not one solid part of an organisation. It shows life-like behaviour wherein it is continually changing and reconfiguring itself according to both internal and external influences.

It is impossible to know in advance what the knowledge-state of an organisation is and what it could or should be. Organisational knowledge is an emergent property of continuous interactions among knowledge containing objects, knowledge creators and knowledge users. It is distributed within an organisation but it is impossible to identify organisational knowledge from the properties of entities that constitute it. Organisational entities perform collective intelligent behaviour to create knowledge from data and information.

Complex Adaptive Systems Approach to Organisational knowledge

An overview of Complex Adaptive Systems

Study of complex adaptive systems (CAS) is an inter-disciplinary subject having roots in physics and mathematics and extending to biology, ecology and artificial intelligence [19][20][21][22][23][24][25][26]. A CAS is a dynamic system made up of many interacting and inter-linked parts or elements whose behaviours are determined by simple rules of local interactions. These elements may undergo changes within themselves or as a result of interactions among elements and the environment (i.e., changes can be developmental, evolutionary or co-evolutionary).

Unlike Newtonian mechanical systems a CAS is not subject to simple cause and effect relationships, and does not maintain a static equilibrium. Instead, system dynamics are non-linear (e.g., small changes in some part of the system may result in significant changes in the behaviour of the system). They may have several stable states (i.e., attractors) and the number of these may change according to internal and external influences. The existence of these several stable states enables a CAS to be robust and to adapt to changes in the environment.

This adaptation is characterised as the ability of a CAS to self-organise by moving from one stable state to another. If some pressure is received from the environment, the CAS moves out of the current stable state into a state of "fluctuations" which will push the system into another stable state provided that environmental pressures are not highly destructive. This transition is termed the "edge of chaos." Another term used with complex adaptive systems is "fitness landscape" which refers to a system's ever changing state-space. Although it is almost impossible to figure out the real structure of the fitness landscape of a CAS, it may improve our understanding of CASs if it is used as a visual or simple modelling tool.

An important characteristic of a CAS is its ability to self-organise and adapt to changes in the environment without a central rule governing its behaviour. This robust adaptive behaviour is an emergent property of interactions among the sub-parts and/or between the environment and the system.

An example of a CAS is ant colony behaviour [20, Pp. 81-82] [27]. Ants can find the shortest path from food source to their nest by simply laying a trail of pheromones, which then attracts other ants. The shortest path is the one ants traverse more frequently and along which they lay more pheromones which then attracts more and more ants. If the current shortest path is distorted, the ants discover the next shortest path, after a period of slight chaotic behaviour by laying pheromones, but not through one centralised rule that lets ants know what would be the next shortest path. How is it that large cities of the world never run out of food even though there is no central authority that regulates food availability? [19, Pp. 1-2] Adequate supplies and availability of food emerges as a result of simple localised actions wherein many restaurants, coffee shops, food shops and so on aim to achieve their own goal of providing for their own customers.

Properties of Organisational Knowledge

In order to better understand the dynamics of organisational knowledge, let's imagine that the following knowledge-relevant entities or agents exist within an organisation or any sub-part of it:

- **Resources**: These are a collection of data and information relevant to business experience. They may exist in the machines (i.e., computers) or in individual minds. A very simplified view of this category may be a static storage unit such as databases, intranets, e-mails, individual employees, etc.

- **Processes**: These are man or machine-based processes in which some form of data or information relevant to conducting business is embedded. These may be viewed as the dynamic form of knowledge resources. Examples are transaction processing, decision support systems, collaborative working groups, best practices etc.

- **Users:** These are man or machine-based units, which convert knowledge into actions. The unit can be a business process or an individual manager.

In reality these agents or entities may not be clearly and discretely defined - they are interconnected, overlapping and interacting. An important factor influencing the behaviour of agents is *change*. An organisation or any sub-part of it is never static. Its dynamic character influences topology and the nature of inter-connection among agents and entities.

A user agent may become a resource agent for a specific knowledge requirement of another user agent. At times, for some users or processes, some of the resources may not be relevant, but in another circumstance the same resource may be vital. It therefore seems that organisational knowledge creation, and the principles for its management, may not be explained with simple prescriptive approaches and rules based on resources, processes, users, and their inter-relationships.

The principles of complex adaptive systems may offer a more plausible approach in explaining the behaviour of these highly dynamic properties of systems that produce organisational knowledge. These systems are composed of many interacting agents of knowledge sources, processes and users.

- **Coupling**: the agents involved in systems creating organisational knowledge are highly interconnected and the behaviour of one influences the other(s). The nature of this inter-connection can be co-operative or competitive. In this sense, agents of the knowledge system are connected to each other and these connections and the nature of the interaction changes over time according to the knowledge required to perform certain business activities. The influences among the agents are not simple cause and effect relationships. A small change occurring between agents may lead to greater changes in some other parts of the system. The degree of coupling among the agents is directly proportional to the likelihood that these small changes may propagate over the system, becoming greater and greater in their effects.

- **Emergence:** Organisational knowledge is an emergent property of interactions among knowledge relevant entities of an organisation or a sub-part of it. It does not come into existence as a result of planned activities for knowledge creation. It is the result of continuous and iterative exploitation of knowledge resources, processes and users in order to create an understanding and experience of conducting business. This understanding and the experiences embodied in it are also subject to change.

- **Self-organisation and adaptation:** The system producing organisational knowledge (and this knowledge itself) continuously changes depending on the pressure from knowledge requirements originating within and outside the organisation. Resources get updated with new data or information; users stop asking for certain resources, and processes do not always serve the same purposes. In this situation organisational knowledge adapts to internal and external pressures through the system's ability to self-organise. This requires that there are a sufficient variety of knowledge agents in the system, and that they can easily be available to respond to the pressures. Variety is the key property reflecting the plasticity of organisational knowledge as it responds to frequent, fast and hostile changes in business practices, and to competition and other environmental factors.

The above properties denote a generalised view of conditions under which organisational knowledge may exist. These properties can help us to develop computational models to simulate creation and dissemination of organisational knowledge. An example of a web-based system using the above properties is presented below.

Towards Computational Models of Organisational knowledge

CAS's are studied in terms of philosophical and metaphorical approaches in the domains of management [28][29][30][31][32][33][34] and knowledge management [9][7][10]. Most of the existing research related to knowledge management and complexity focuses on borrowing general concepts and ideas from the scientific studies of complexity and applying it to the knowledge management context. In this context, it seems that the majority of interactions between scientific research in complexity and knowledge management is occurring at analogical, metaphorical or philosophical levels. This interaction challenges existing managerial paradigms and provides a new way of thinking about organisational systems. According to this new paradigm, knowledge dynamics are non-linear, sensitive to initial conditions and subject to emergence. An organisation is most creative and innovative when it is at "the edge of chaos" and it moves along its "knowledge fitness landscapes".

Since the study of organisational complexity is young, it is only natural to expect to see these speculative and analogical approaches. But how useful are these approaches to managers (or management scientists) when they are faced with some profound difficulties in knowledge management? Can we (should we) adopt the conceptual framework of complexity for the knowledge management needs of every organisation? Under what conditions does organisational knowledge fit into the complexity framework? How do we know a knowledge organisation is at "the edge of chaos"? What is the shape of a particular organisation's knowledge fitness landscape? What are its characteristics? Unfortunately, there appears to be no in-depth research in the area to answer these questions. It is reasonable to ask whether qualitative analysis and analogical speculation can lead to codifiable knowledge about knowledge. I think these are interim solutions and that qualitative analysis will never enable us to understand the knowledge landscape for a particular situation or an organisation as a whole.

In order to provide answers to the above questions, it is essential that research in complexity and knowledge management go beyond existing metaphorical analysis. Instead, it should focus on identifying when and how complex dynamics can be observed within knowledge creating organisations and what the implications are. However, ad-hoc set-ups or trial and error approaches (even if rigorous efforts focusing on collaborative units and knowledge bases) aiming to understand knowledge dynamics may not be fruitful. At times they may even prove to be risky because the operations of an organisation within a fast changing and hostile environment may exert substantial sensitivity to the dynamics of creation and use of organisational knowledge. Instead the principles of complex adaptive systems and techniques of a-life (such as genetic algorithms, simulated annealing, artificial neural networks, etc.) may serve as modelling tools in simulating and understanding the dynamics of knowledge creation and dissemination in organisations.

A-life techniques are already being extensively used in developing theories about adaptation, complexity, chaos and order as observed in nature. For example Kauffman [22][23] uses Boolean networks and simulated annealing methods in developing the NK-landscape and patches models. Langton [21] and Wolfram [35] use genetic algorithms in modeling complexity using cellular automata. A-life methods are an essential and useful part of complexity research, as they enable scientists to model complexity using computers and to understand its underlying dynamics. Similarly, moving beyond an analogical/metaphorical perspective, techniques of a-life can be used in modeling dynamics of organisational knowledge for particular situations/processes within organisations. This approach may result in a more concrete understanding of typical complexity dynamics faced by knowledge managers.

But what should be the procedure of studying organisational knowledge? How can A-life techniques be used in modeling deceptively complex knowledge dynamics within organisations?

A holistic and top-down view of knowledge within organisations is only useful to explain global properties of knowledge within a business context. For example, organisations know that best practices are important, and that they should provide necessary infrastructure to allow individuals to discuss these practices with others, and wherever possible to record them. Also, organisational knowledge is often portrayed in terms of managerial decision making processes. These approaches are similar to GOFAI's holistic view of intelligence and efforts to simulate how the human brain works.

Understanding the details of how knowledge (e.g., a best practice) is created and how it is used for improved decision-making is a difficult task. Attempting to explain knowledge dynamics within an organisation with a holistic and top-down approach leads to the kind of limited discovery characteristic of the GOFAI experience.

Developing tools for knowledge management using a-life methods, on the other hand, requires that such details should be investigated in small proportions for small knowledge relevant tasks. Knowing that organisations move along *knowledge landscapes* has little practical use to business managers facing a specific decision task. A particular knowledge relevant task has its own dynamic knowledge landscape that might be easier to visualise and simulate. Following the NEWAI approach, explorations of small manageable domains can help us understand basic or primitive knowledge dynamics, which in turn might lead to general theories of *adaptive* knowledge management.

An example application dealing with web-based search is provided later in the paper. In this example, rather than focussing on the problem of search on the Internet, a small manageable size intranet is chosen as a domain of study.

Also, a holistic view or top-down modeling of knowledge complexity for an organisation has the danger that analysis of knowledge complexity in organisations may always be influenced by the perception of complexity in the mind of the observer/designer (i.e., similar to design of intelligence by the GOFAI researchers). Using a-life methods may provide us with an ability to discover not only expected properties of knowledge for a particular knowledge relevant task, but possibly some properties which we could have never imagined. We might gain insights into the dynamics of knowledge *both as-we-know-it* and *as-it-could be*. In other words, we can know better the knowledge *we know we have,* and also may discover the knowledge *we do not know we have or do not have.*

By modeling simple knowledge dynamics belonging to small manageable domains within organisations, one can also observe whether parallels do indeed exist between scientific complexity and organisational knowledge. If organisations possess the characteristics of complex adaptive systems, then computer models may help us to understand the emergent phenomena of knowledge dynamics.

With computer modeling, the concepts of complexity such as "edge of chaos", "fitness landscapes", and "self-organisation" will become more meaningful. This development might initially be within the context of knowledge dynamics belonging to small domains or tasks, but can lead to the formulation of theories about organisational complexity and knowledge management in general. This approach may not only help us to understand organisational knowledge better, but lead to an experimental scientific field of adaptive knowledge management or adaptive management in general

Computational approaches can be useful in identifying typical aspects of organisational knowledge, which may or may not be different than those proposed by scientific complexity research. They can provide us with more concrete knowledge of conditions under which organisational knowledge exists and its practical implications for managers. The work in the area desperately needs theories of "organisational knowledge" of its own. Since experimenting with real organisations is difficult, time consuming and risky, computer modeling for studying organisational complexity appears to be the only viable alternative.

Computer models are robust, faster, more flexible and less expensive than real world experiments. As McKelvey [36] points out: "without a program of experimental testing, complexity applications remain metaphorical and are difficult to distinguish from witchcraft."

An Application: An Adaptive Knowledge Portal

Since businesses are operating in fast changing, uncertain and, often, hostile environments, the structure and plasticity of the knowledge must keep up with demanding environmental requirements. In this respect knowledge portals should be adaptive to the changing requirements of the user/environment. One way to achieve this is to develop an *adaptive knowledge portal* (AKP) to reflect evolutionary dynamics of knowledge-life within business organisations.

Unlike the rigid hierarchical organisation of content and indexing mechanisms employed by existing web-portals, the AKP makes use of principles of self-organisation and complex adaptive systems. Because of this reliance, an AKP can better respond to the ever-changing knowledge-state of the organisation and to the needs of its decision-makers. The need for the AKP and an overview of it are presented in greater detail in [11].

A simple search in an indexed intranet will deliver a set of documents most of which are highly likely *not* to be the ones which would satisfy the user's or the business's needs. This is not focused and personalised knowledge delivery. In fact, indexing strategies may be one of the major factors of information overload within the company. Applehans et al. [37] suggest that one way to avoid problems of indexing is to establish a "common vocabulary" of the site. In order to have a common basis for moving content from sources to users "you need to establish a set common vocabulary that will be used across all repositories you are seeking to manage" (p. 78).

The problem with this, however, is that various individual users and various departments may have drastically different views and interpretations of the content. Additionally, the common vocabulary may not be sufficient to bridge these differences. Moreover, for businesses in changing and dynamic environments, such rigorous efforts soon become obsolete, since this vocabulary will change with the changing business focus, if it is possible for it to change meaningfully at all.

Instead of trying to understand content through a common vocabulary, a common understanding of content distributed over different parts of the company should be seen as an *emergent property* of inter-actions of users, keywords and documents. In this way the need for maintaining an indexing mechanism based on a keywords-to-documents mapping becomes less and less important. An adaptive knowledge portal is an effort to simulate dynamics of interaction among the three essential components (users, keywords, and documents) of a web-based knowledge environment.

A typical expectation from a well-organised intranet is an efficient searching mechanism where given a set of keywords, a user should receive a manageable number of documents that satisfy his/her needs. A core unit in the AKP is an adaptive search engine (ASE). Rather than keeping track of keywords-to-documents mappings, an ASE keeps track of user-keywords-documents mappings and additionally it tracks the satisfaction level of the user. The satisfaction level may be determined from input of the user, or indirectly by observing if recommended documents are being selected and read, printed or e-mailed.

The ASE is being developed at the University of Surrey. ASE uses a host and parasite analogy. Keywords are parasites. To survive they continuously look for host documents. Both documents and keywords have to maintain a certain level of life or energy to exist together. The life of the document and the keywords are in competition. Each keyword consumes energy from a document and each document tries to minimise the number of keywords attached to it. This is important for focused and personalised recommendations. The life of the keywords and the documents gets rewarded or punished according to how well they respond to user requests given a set of search keywords. If a document satisfies a user's needs its energy increases, and then this gets transferred to the energy of the keywords used in the search, showing a strong connection between hosts and parasites.

This is important in determining which keywords are related to which documents according to the users' requirements, but not as a fixed set of predefined keywords and serves as a dynamic evaluation of users' satisfaction. Based on continuous evaluation of user satisfaction, it is possible to form a personalised view of the intranet for each individual. This is a localised success of the ASE where given a set of keywords, a particular user’s preferences for certain documents may be known with some precision. Which of the documents will be presented to the user is determined by the history of complex interaction of the user-keywords-documents. Overall success of the ASE depends on the satisfaction level of a proportion of the users.

In a typical scenario many users will have conflicting views of the content and it will be impossible to satisfy all of the users. The aim of the ASE is not to find an optimal users-keywords-documents mapping but rather, to maintain a dynamic state where most of the users are satisfied *and most importantly, the satisfaction level of the users can be maintained under changing circumstances.* This is where the adaptive aspect of the knowledge portal becomes important.

Conclusions

One of the urgent needs of today's businesses is to be able to organise knowledge in order to cope effectively with complex dynamics of processes of both knowledge creation and knowledge use. These dynamics show properties of frequent changes and the need for personalisation, thereby requiring organisations to adapt to evolving knowledge requirements of the users, both internal and external.

Organisational knowledge is created from the understanding gained from the experience of conducting business. It is dynamic and continually changing in order to provide effective responses to the changing requirements of the business and the business environment.

Typical analysis of organisational knowledge refers to either the explicit-tacit taxonomy, or the data-information-knowledge continuum. However, neither provides a sufficient explanation of the dynamics of organisational knowledge. Organisational knowledge may be better understood using the principles of complex adaptive systems and building computational models of creation and dissemination. A-life techniques may be used to build such computational models. This approach is useful not only because it reduces the problem of knowledge management to smaller and understandable proportions but also because it may lead to an empirical scientific field of complexity and knowledge management.

This paper presented an overview of a simple knowledge management tool: an adaptive knowledge portal that aims to provide users of intranet applications within an organisation with personalised and up-to-date content. Using the properties of organisational knowledge and techniques of a-life, an overview of design guidelines for a web-based adaptive search engine was introduced.

Understanding the dynamics of knowledge creation and dissemination is essential for success in knowledge management. Ideas developed in this paper advocate an evolutionary and adaptive perspective. The benefits of this approach can best be realised using computational models of organisational knowledge rather than a paradigmatic metaphorical approach to the complexity of organisational knowledge.

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Biography

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