

The Agile Organization: Technology & Innovation

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Abstract

In this paper we consider the role of information technology and innovation within the context of an *agile organisation* performing electronic commerce. The paper will utilise Schein's sociotechnical model of innovation to consider the relationships between structure, process, innovation, technology and organisational culture, and focuses upon innovation and technology, examining six of Schein's sociotechnical hypotheses with respect to how artificial intelligence impacts the organisations ability to be agile, connected and innovative.

1. Introduction

Recent works on electronic commerce (Kalakota, 96, 97a, 97b) have focused upon the emergence of the internet as a mechanism that facilitates inter-organisational commerce. This paper examines how technology influences organisational change such that enterprises can be competitive in the electronic arena. The basis of competition is anticipated to be that of low cycle time, mass customisation markets and hence the need for organisations to become increasingly connected and agile. The paper examines the relationship between structure, process, innovation, organisational culture and technology. The paper primarily builds upon the work of O'Leary, Kukka and Plant (O'Leary.97) in examining the role of artificial intelligence as an enabling technology for agile organisations.

2. Background to the Agile Organization Concept

An Agile Organization when considered from a *systems* perspective can be defined as follows:

An agile organization is one that competes with a multi-dimensional strategy based in competitive flexibility. The agility of the organization comes from the organization's ability to create custom-quality products in short production runs, on-demand, interspliced with production of other products on the same production line, at low cost, with high reliability, and low cycle time. The production may be located at any global location internal or external to the knowledge-source of the organization. The knowledge-source is the functional management group that performs command, control and communication of the organization through its systems and connectivity with the environment, internal and external to the organization. The systems not only act as the support for the organization but also as the nervous system of the organization allowing it to react to any external stimuli or competitive forces. In addition to the flexible positioning of the production, the sourcing of supply is also flexible, connected and controlled through computer networks and systems. This concept of systems flexibility, support and control are integrated into all aspects of the organizations value chain, in all of the support and primary activities. Thus allowing the organization to continually re-invent itself and thus continually compete in a global marketplace.

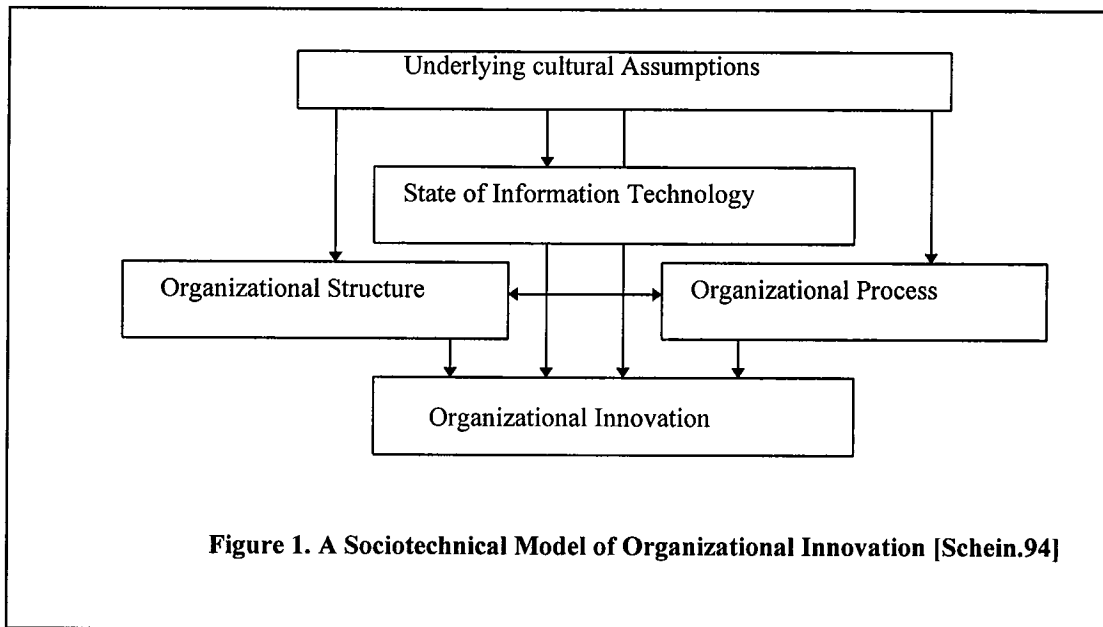
From this it can be seen that the ability of an organization to be considered agile is complex and multidimensional.

3. Technology Innovation and Organizations

The transformation of an organization from one state to another requires vision and leadership from senior management, but further it requires that the organization possess the property of organizational innovation. The area of organizational innovation has been described by Schein in relation to traditional organizations and the transformational processes that they experience (Schein,1994). We will utilize his sociotechnical model (see Figure 1) of organizational innovation to consider the context in which an agile organization exists.

- The achievement of flexibility in all aspects of the organizations value chain
- That information systems are the primary drivers of that flexibility.
- Inter-corporate relationship management is vital to the organizations ability to position itself within electronic communities of commerce
- Human resources are based upon knowledge workers
- Creative interaction between knowledge workers, systems and extra-corporate entities facilitates the competitiveness of the organization

Having created a set of cultural assumptions, their impact upon the other sociotechnical processes can now be assessed.



3.1 Underlying Cultural Assumptions

It has been determined (Schein,1985) that a primary issue in competitiveness and organizational adaptability is that of organizational culture. The culture of an organization manifests itself ultimately in its mission and vision, which is an embodiment of the collective philosophy of the organization. In an agile organization the cultural assumptions are based upon factors such as:

3.2. Information Technology

The organizational culture will carry over and directly affect the information

technology that is present within an organization. The technology utilized appears in response to, and in support of, that culture. The cultural characteristics outlined above, all point to the need for a flexible and open systems culture. These systems will be increasingly interconnected both intra- and inter-

organizationally, following and creating standards and protocols. Further the use of systems to reduce cycle time requires an increased operational dependence and hence operational risk upon critical systems. The support systems can be easily managed and even outsourced to third parties, the development of new strategic systems being an aspect of the research and development arm of the organization. These new strategic systems evolving quickly into the operational usage, both to maintain competitiveness and to increase flexibility. The vital component that holds all these technological aspects together is the human factor, the knowledge workers at both the systems level and the strategic level. The organization being based upon the use of sophisticated technologies requires its workforce to be equally skilled and flexible.

3.3. Organizational Structure

The organizational culture also directly affects the organizational structure. The nature and configuration of work practices and processes. The socio-technology model assumes that the structure can not be separated from the culture of the organization. This can be applied to the agile environment where the culture of change through information technology is accepted and that this acceptance leads to the flexibility of working practices by the employees, and flexibility of processes within the organization.

3.4. Organizational Processes

The culture adopted by the organization is also reflected in the nature of the organizational processes and the communications that surrounds these processes. The transformation of the value chain processes through technology impacts both the support and primary activities. The focus of these changes being the move towards flexibility of the processes, both in terms of function and speed of operation: the fundamental basis of the agile organization.

3.5. Organizational Innovation

The sociotechnology model of Schein identified the relationships that occur between the culture, structure, processes and information

technology of an organization to create an innovative enterprise.

Adaptation of Schein's assumptions allows the underlying nature of the agile environment to be seen more clearly.

1. The marketplace is in continuous state of flux but that the organization can be continually repositioned to be effective in that market.
2. The knowledge workers of an agile enterprise are themselves in a continuous state of skill enhancement to match the needs of the market.
3. The agile organization positions itself to both be successful in a short term relationship and a brief life-span market place. It also capitalizes upon its experiences to be successfully positioned for long-term organizational success.
4. The organization can work in several markets at the same time each of which have differing competitive time planning horizons.
5. Markets involve inter-corporate communities of interest.
6. The form of the market place is in part or totally electronic.
7. Subcultures exist within the marketplace.

From this we can identify what Schein defines as *characteristics of an information technology for innovation*, and adapt those characteristics for an agile organization. These characteristics are defined through a series of hypothesis (Schein, 1994), six of which will be examined in light of the agile competitive philosophy in section four.

4. Information Technology for Innovation

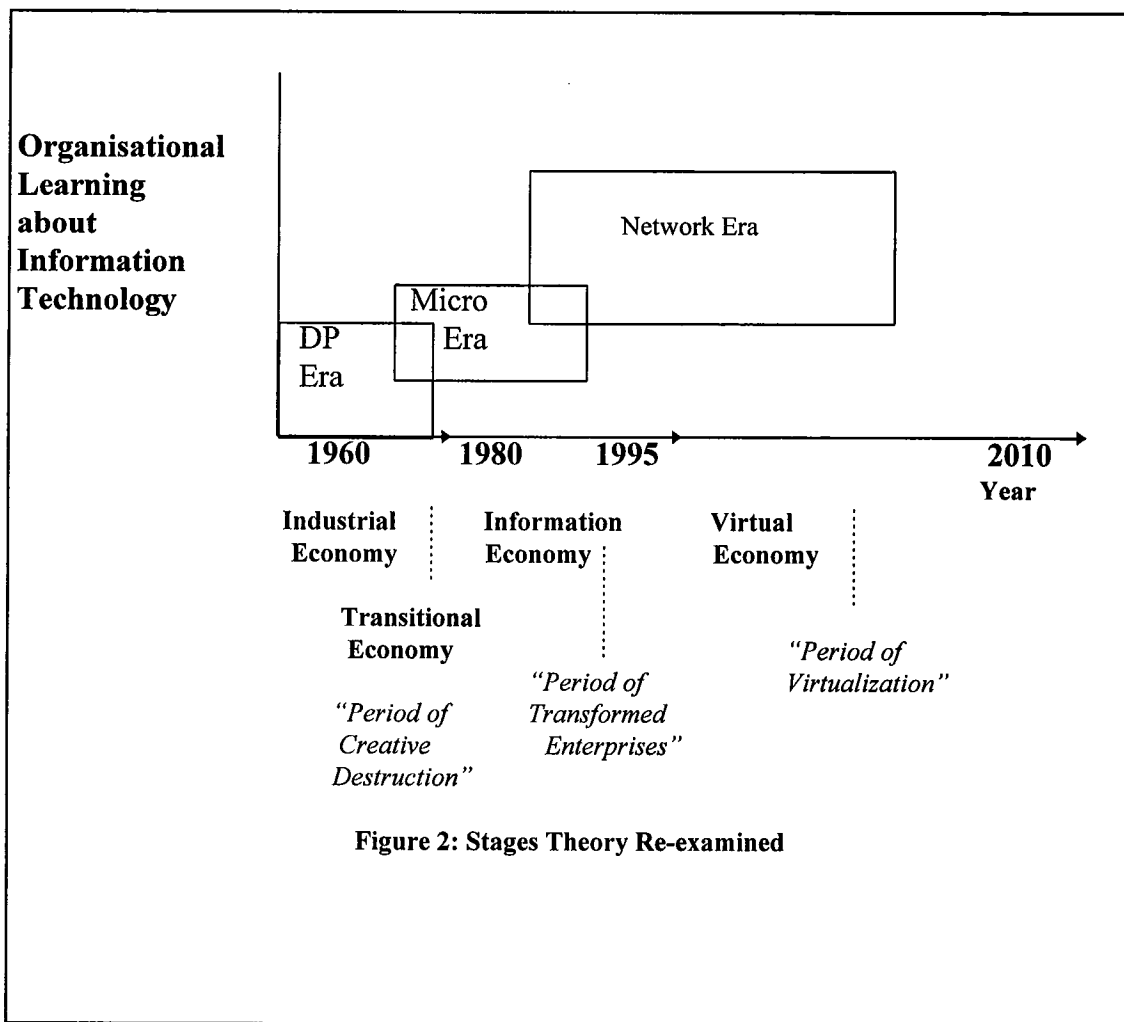
In this section we will examine the agile organisation through six of Schein's hypothesis in relation to information technology, with special emphasis placed upon the role of artificial intelligence to each.

4.1 Networking Capacity:

Hypothesis IT1: *The capacity of an organization to innovate to the extent that it has total networking capacity(Schein, 1994)*

The agile organization can be defined as the complete networked organization. The progression of the organization from a support, unconnected organization to this agile state follows the three stages of Nolan and Seger's model in which three, S-shaped curves that "reflect organisational learning on major informational technologies" (Nolan and Seger, 1993), these curves representing three eras: the data processing era; the micro era; and the network era (See Figure 2).

networked capacity, both internally and externally, the intra and inter-nets, confirming Hypothesis IT1. We can extrapolate the third era and consider the evolution of the technologies in this era. This is illustrated in Figure 3 and shows that the organisation progresses through a series of levels of technological competence and understanding. The progression starts with development of intra nets with basic client server technologies, followed by inter-connectivity via standard protocols. A phase of web construction follows and the creation of secure transaction facilities through the Secure Hyper Text Transfer Protocol (S-HTTP). The highest phases of organisational connectivity are centered around the use and manipulation of knowledge, both internal knowledge and external knowledge. The



In considering the agile organisation and the networked era we identify the organisation as moving towards a total

knowledge is used operationally, tactically and strategically by the agile organisation in its relations with external entities. The use of

knowledge and the creation of a highly connected organisation is achieved through the utilisation of artificial intelligence. The basis of which is the use of intelligent agents, knowledge-based systems and virtual reality models, through standards and applications built around those standards.

The ability to route and filter information adequately as the volume of information continues to grow is an area where artificial intelligence is both applicable and indispensable. The combination of the two hypothesis indicates the need for organisations to perform wider environmental scanning with the

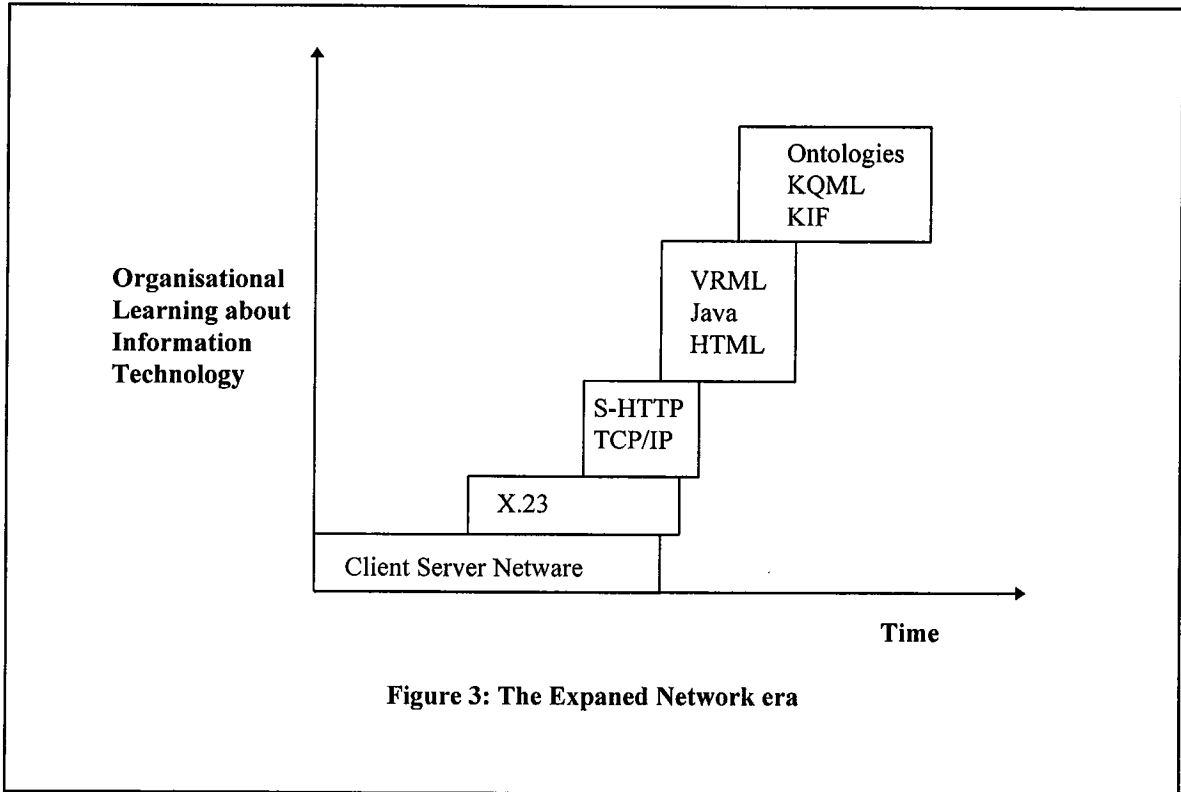


Figure 3: The Expanded Network era

4.2 Routing and Filtering Capacity

Hypothesis IT2A: *The capacity of an organization to innovate increases to the extent that it can open and close channels as needed (Schein, 1994).*

Hypothesis IT2B: *The capacity of an organization to innovate increases to the extent that it can filter information into the channels as needed (Schein, 1994).*

The agile organization is based upon the ability to innovate but also to respond to market demands faster and more profitably than any other type of organization. This is grounded in the ability to open and close channels to meet specific and often novel market conditions and that the organizations self-understanding of its processes, through its virtual value chain allows superior information filtering to occur.

ability to access more channels than ever before. These activities can be performed in part or entirely by autonomous intelligent agents. The leading area in which this is occurring is that of smart procurement, in which product information can be obtained autonomously and remotely by agents over a network such as the

internet., e.g., part.net, commerce.net. The procurement process can occur autonomously through arbitrage performed by neural nets or knowledge-based systems which analyse and filter the quotes from vendors against organisational requirements, previous histories and profiles of the vendor.

Filtering can also take place through the organisations connectivity with the external world and external networks through intelligent search engines such as SemioMap

(www.semio.com/) which organises search results by concept and aims to uncover relationships between internet and intranet documents.

4.3 Connectivity to environment, “openness” of the system

Hypothesis IT3: *The capacity of an organization to innovate increases to the extent that it has several open channels to and from its environments (Schein, 1994).*

The connectivity of the agile organization is key to its ability to compete and innovate. The organization is connected to members of its community through its inter-organizational systems and then connected to its extended communities through the value systems of its electronic community members. This allows it to create adaptive, innovative and novel solutions to new market forces and demands.

The value of artificial intelligence is clear here, the internet and its standards are the key to allowing universal access to customers and suppliers. The standardisation also lowers entry barriers and therefore opens new markets with low a cost of access to those markets.

The key standards are in the language definitions e.g., Knowledge Query and Manipulation Language (KQML), Knowledge Interchange Format (KIF), and Virtual Reality Markup Language (VRML). The Knowledge Query and Manipulation Language provides a messaging format and a message handling protocol to supports run-time knowledge sharing amongst agents. The sharing of knowledge being supported by communication facilitators that coordinate the agents and a set of performatives that define permissible operations between agents. The ability to create and execute messages is increased through other data and information protocol formats and standards. The Knowledge Interchange Format allows knowledge to be exchanged between programs acting as an “interlingua”. KIF is a prefix version of first order predicate calculus with extensions to support non-monotonic reasoning and definitions. The language can also represent meta knowledge and is therefore also suited to the creation of knowledge-based systems (Plant, 1997). The current development of these two formats is in the sharing of information in a

distributed setting as a part of the Shared Dependency Engineering (SHADE) project within which many agents that adhere to those protocols have been built and are available e.g., contents-based router, matchmaker, control agent, ParMan (<http://www-ksl.stanford.edu/knowledge-sharing/agents.html>). As the connectivity of organisations increases so does the necessity to interact not only through data but visually. This can be achieved through virtual reality modeling and is supported by VRML. The supplier-buyer relationship of many organisations is becoming increasingly dependent upon low cycle-times and high quality work, a circumstance that increasingly requires connectivity through VR modeling. The connectivity theme is a continuing one in research, as is that of shared information, as can be seen with the ARPA program in knowledge sharing that aims to facilitate the reuse of knowledge bases and knowledge-based systems. The ability to link these standards protocols and formats with projects such as CYC (which uses its own language CycL (www.cs.umbc.edu/~narayan/proj/doc.html)) will enable significant progress to be made with respect to corporate knowledge-based systems construction..

4.4 Capacity to evolve one’s own IT system technologically

Hypothesis IT4: *The capacity of an organization to innovate increases to the extent that it can fully understand and implement innovations in information technology itself as these may apply to various aspects of an organization’s tasks (Schein, 1994).*

The ability of the agile organization to understand its own processes and re-configure these in relation to the market demands is key to the organizations competitiveness. The ability to re-configure systems is based upon the intranetwork of the organization and its flexibility. This is enhanced through the use of corporate knowledge-based system, which become the organisations repository of learning. The effects of artificial intelligence elsewhere in the organisation will be enhance through such mechanisms as neural networks which will also enhance the organisations ability to capture its own knowledge and grow from it.

4.5 Presence of an IT subculture

Hypothesis I/C 1: The capacity of an organization to innovate increases to the extent that it has somewhere inside itself a fully functioning, technologically sophisticated IT system that can be a demonstration of IT's capacity and a source of diffusion to other parts of the organization (Schein, 1994).

The creation of an IT environment that progresses through the network era as illustrated in Figures 2 and 3 would necessitate the creation of an innovative information-intense community of systems staff. The agile organisation requires these high degrees of sophistication in order to compete effectively, as more organisations move towards hyper-connectivity or fail. The artificial intelligence component is a sub-community within that system group, as would a database group be a sub-community.

5. Conclusions

Through the analysis of this section we have identified several of the keys to becoming agile and that central to these is the ability to be an innovative. An innovative organization is not necessarily agile, but an agile organization has to be innovative to compete and survive in other than the short term. The paper identifies the relationship between the culture of the organisation and information technology. Further, the ultimate enabler of agility through technology is the artificial intelligent component. AI demands greater organisational internal understanding of technology and thus is only applicable to mature organisations that have internally streamlined processes and a high degree of connectivity but who wish to become a knowledge based organisation.

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