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THE SYNERGY OF LEARNING ORGANISATIONS AND FLEXIBLE INFORMATION TECHNOLOGY

George Rzevski *, Kumkum Prasad **

** The Open University, Milton Keynes MK7 6AA UK*
*** Kingston University, Kingston upon Thames, Surrey KT1 2 EE*

Abstract
The switch from the Command-and-Control to Learning Organisation paradigm in the area of organisational theory is well understood. It is less well appreciated that learning organisations cannot operate effectively if supported by centralised data processing systems. The paper argues that there is a need for synergy between organisational structures and organisational information systems. Learning must be supported by the so-called new information technology. To obtain desired synergy it is necessary to design organisations and organisational information systems concurrently.

Keywords: concurrent design, information systems, intelligent systems, learning organisation.

1. INTRODUCTION

Information systems are the integral part of the organisational structure. This is a fact often overlooked by information technologists. The organisational structure defines the distribution of authority among managers, segmentation of functions and patterns of relationships among the functional units. It encompasses governance, reporting relationships, communication and information systems, measurement and reward systems, as well as planning and control systems (Galbraith 1977), (Nadler 1979). Furthermore, "Organisational structure must perform the major functions of facilitating the collection of information from external areas as well as permitting effective processing of information within and between sub-units which make up the organisation" (Tushman 1978).

Based on above considerations, let us postulate that *the role of information technology is to provide an effective collection, storage, processing, distribution and utilisation of information in an organisation with a view to increasing the effectiveness and satisfaction of users. C*onsequently, frameworks for future information systems theories must be considered in the context of organisational and management theories. The importance of the close link between the domain of organisational theory and the domain of information technology cannot be overemphasised.

Recent changes in the organisational theory and practice cumulatively amount to a major paradigm shift from the *Command-and-Control* to *Learning Organisation*. This shift was in the making for more than 30 years and is rapidly spreading in all sectors of industry in the West under a variety of labels, such as 'Intelligent Organisation' and 'Participative Organisation'. The new organisational paradigm requires radically different information flows and thus radically different supporting technology. It is inconceivable that flexible and distributed organisations can be supported effectively by the traditional centralised information systems, corporate databases, large mainframe application programs and data-driven structured methodologies. The central thesis of this paper is that the most effective way of ensuring a close match between an *organisation* and its supporting *technology* is by designing the two concurrently.

2. EVOLUTION OF ORGANISATIONAL THEORY AND PRACTICE

With the advent of the early industrial era, around 1750, the Western society faced its first major period of discontinuity when the feudal organisational model became obsolete and the new industrial model was in the development. Methods based on agricultural era principles and concepts proved inadequate to cope with problems of mechanical technology. However, until the middle of the 19th century the volume of industrial activity was not large. The typical enterprise remained small and personal, usually run as a family business, and the owner was normally capable of administering the business himself. By 1880s new technological and scientific inventions eg, the telephone, telegraph, the railways and electricity, had paved the way for important changes in organisational structures. By this time, the Proprietorship model, which was developed in the early industrial era, was being replaced with the Command-and-Control model. The new organisation was characterised by steep management hierarchies, the separation of ownership from management, the separation of thinking from doing, short spans of control and clear command lines - one person one manager.

Adam Smith (1987) and Babbage (1963) laid early foundations but the key concepts of the Command-and-Control Model were established by three important management schools: The Scientific Management School (Taylor 1947), (Gantt 1916), (Gilbreth and Gilbreth 1917); Administration School (Fayol 1949), (Urwick 1943), (Mooney 1931) and Bureaucracy School (Weber 1946). The background influences on which the Model was based were military, engineering, physiology and classical economics. It is important to note that the Command-and-Control Model was developed incrementally and that the main impact of this model on the society was felt only when practitioners began to apply it and further extend its principles. For example, when Ford introduced production line and mass manufacturing and Slone of General Motors Company established divisional functional structure, which persisted until very recently as the only viable way of organising big businesses.

The downfall of the Command-and-Control model came only very recently heralded by crashing losses incurred by industrial giants such as General Motors and, in particular, IBM. The causes could be easily traced to the surplus of supply over demand due to the unprecedented increase in competition primarily from the countries of the Pacific Rim. Demand for mass-produced goods drastically decreased. High quality, reliability, safety, environment-friendliness, customisation, frequent changes of models and short concept-to-market lead times became main critical success factors. After a short period of hesitation and experimentation with a variety of concepts imported from Japan, such as Just-in-Time, Lean Production and Total Quality Control, and prompted by emotional articles from Harvard Business Review such as Hammer's 'Don't Automate, Obliterate' (Hammer 1990), Western companies began a serious restructuring. The change is still patchy but there are many examples of companies abandoning almost all Command-and-Control concepts.

3. LEARNING ORGANISATION

A new system of concepts defining organisational structures and cultures has gradually emerged under the name of *Learning Organisation*. It comprises: shallow hierarchies, small power distances, interdisciplinary teams of well educated employees, process-oriented organisational units and global partnerships between independent companies along and across value chains. It is useful to define Learning Organisation by the manner it interacts with its environment. A Learning Organisation is capable of learning about (and from) its environment and adapting itself to it. Advanced learning organisations are, in addition, capable of changing their environments with a view to achieving desired goals. A competently designed organisation can exhibit more intelligent behaviour than the sum of intelligence of its employees. This enhanced intelligence obtain through the rich interaction of people who constitute the organisation is named the *Emergent Intelligence*.

The early work on building foundations of the new paradigm began under the title of

'Human Relations Approaches' and, later, 'Neo-Human Relations Approaches' by Mayo (1933), Maslow (1968), McGregor (1960), Likert (1961) and others. It advocated close co-operation between employees and management. This approach was heavily influenced by the social psychology and sociology of the time and was proposed in protest to the Scientific Management Model. Much later, similar thoughts were expressed in various versions of open system models of the organisations, including Contingency Theory (Lawrence and Lorsch 1970). Contingency theorists attempted reconciliation between the rational traditional school on one hand and human resource theorists on the other. They placed a great emphasis on congruence as the key to effectiveness and strive to prescribe organisational designs and managerial actions most appropriate in specific situations. A series of books written in a more popular fashion, some describing Japanese experiences in a somewhat over enthusiastic manner, contributed to the greater awareness of practitioners of major weaknesses associated with the Command-and-Control Model under new volatile market conditions (Rzevski et al 1993). In the USA, the final push was provided by articles of Drucker (1992) and Hammer (1990). The acceptance of the need for a radical change is by now almost universal.

The emphasis on learning is however very recent. The definition of emergent intelligence is new. It is important to note that the Learning Organisation Model, very much like the earlier Command-and-Control Model, was developed incrementally, the development being led by academic researchers. Practical implementations lagged and occurred in earnest only when drastic changes in market conditions made the change in organisational structures unavoidable.

Some of the earliest work in the direction of organisational learning has been done by Argyris (1977). According to him "organisational learning is the process of detecting and correcting errors that inhibit learning". Argyris distinguishes two types of learning: The single-loop learning, which occurs when the organisation learns to do better what it is currently doing and double-loop learning, which is the learning that results from questioning organisational goals and policies. Double-loop learning is inhibited because people in organisations have a 'theory in use' which leads to information being withheld, or being vague and ambiguous. To change these behaviours, individuals must change their private assumptions, or theories-in-use. The change involves: (1) becoming aware of the private assumptions, (2) understanding how these assumptions inhibit double loop learning, (3) developing new assumptions to facilitate learning and (4) developing the skills necessary to implement the behaviour which follows from the new set of assumptions. The capacity for double-loop learning comes from: (a) reliable information, (b) competent people and (c) continually monitoring the effectiveness of decisions.

One of the more widely cited frameworks for organisational learning is Senge's five disciplines. According to (Senge 1990) the learning organisation is still at an "invention stage" i.e. the principles perform well and hold promise in controlled "laboratory conditions". The ideas will become "innovative", when these principles can be replicated reliably and applied on a meaningful scale, with successful results in real life situation. He believes that five "component technologies" are gradually converging to innovate learning organisations. Though each of these technologies are developed separately, nevertheless the contribution of each provides a vital dimension in creating an intelligent organisation. Senge postulates that the process of change leading to organisational learning will only take hold once managers start systems thinking, which involves "a shift of mind - seeing interrelationships rather than linear cause-effect chains, and seeing processes of change rather than snapshots" (Senge 1990 p 73). Senge builds his work on systems dynamics, a form of systems theory, which was developed for modelling purposes by Forrester (1961). Forrester developed an early application of systems theory to the business world, in this case to the study of industrial dynamics, an approach which achieved fame when it was used as the basis of the 1972 study *The Limits to Growth.* Senge quotes the CEO of a large Insurance company: 'If the learning organisation is so widely preferred, why don't people create such organisations?' The answer, he says, is leadership. People have no real comprehension of

the type of commitment it requires to build such an organisation. He goes on to discuss the qualities leaders need. Leader, he says, are designer/teachers/stewards. They need new skills, the ability to build shared vision, to bring to surface and challenge prevailing mental models. In short, leaders in learning organisations are responsible for building organisations where people are continually expanding their capabilities to shape their future.

“Building learning organisations involves developing people who learn to see as system thinkers see, who develop their own personal mastery, and who learn to surface and restructure mental models, collaboratively. Given the influence of organisations in today’s world, this may be one of the most powerful steps toward helping us “rewrite the code,” altering not just what we think but our predominant *ways of thinking.* In this sense, learning organisations may be tool not just for the evolution of organisations, but for the evolution of intelligence.” (Senge 1990 p 367).

Senge suggests that there are five disciplines inherent in Organisational Learning: personal mastery, mental models, team learning, ands shared vision, which are all linked through the fifth discipline, systems thinking. He describes personal mastery as the individual commitment to develop one's own capacity and the capacity of others to create the future. The discipline associated with mental models enables individual to achieve breakthrough in communication through the surfacing and testing of assumptions. Team learning is the development of the collective capacity for thought and action. Shared vision is the collective element of personal mastery as individuals come together to develop a sense of common purpose. Finally, systems thinking is the ability to understand the cause and effect of relationships inherent in the variety of systems in which individuals and groups operate.

Huber (1991) presents an alternative framework for learning organisations based on four constructs and associated processes. The Knowledge Acquisition construct is the most well developed with five subconstructs which contain even further subconstructs. Huber argues that knowledge acquisition includes the knowledge residing at the birth of the organisation (congenital learning) plus knowledge gained directly through experience or vicariously through the experience of other organisations. As well, organisations institute programs of directed search including environmental scanning, and they may also graft knowledge onto the organisation by acquiring other organisations. Information Distribution is the second construct, which captures the notion that information needs to be shared to be of potential value to the organisation. However the organisation needs to be able to interpret the information before it can be considered organisation knowledge. Huber refers to this latter process as Information Interpretation. Finally, Huber suggests that knowledge needs to be stored in Organisational Memory so that it can be called upon by a variety of individuals as required.

One of the unique aspects of Huber's framework is the marriage between an information processing view of learning and an interpretative perspective. The information processing perspective focuses on information acquisition, distribution and storage, while the interpretative perspective focuses on the process of interpreting data and developing shared meaning. Huber draws together the literature of the two fields in a complementary fashion.

From the brief description of the Senge and Huber frameworks it is clear that they offer very different conceptualisations of learning organisations. However there is an important common thread linking both of them, they suggest that learning occurs at three levels: individual, group and organisation. For Senge, personal mastery and mental models focus on the individual while team learning and shared vision focus on the group. Finally, systems thinking can be thought of as an organisational level construct, as one understands how the systems, structures, procedures and organisational actions affect one another. For Huber, knowledge acquisition occurs at the individual level, while information distribution and interpretation occur at the group level. The organisational memory represents organisational level. The unique strength of the Senge model is its development of the individual and group aspects of learning along the softer dimensions of emotion, aspiration

and vision.

4. THE CONCEPT OF INTELLIGENT ORGANISATIONS

The approach adopted by authors of this paper is to start from the premise that learning can only occur if members of an organisation are (1) given certain freedom to decide on their tasks and the way these tasks are best performed, (2) are provided with opportunities to search for, acquire, store and use relevant information presented in a user-friendly fashion and (3) have well developed intellectual capabilities. Translated into language of information systems, this amounts to (a) building into organisational structures certain amount of uncertainty, (b) developing systems capable of providing information in multimedia form aimed at dynamically reducing the uncertainty and (c) employing natural and artificial intelligence to make decisions under conditions of residual uncertainty. Therefore the three concepts that are fundamental to the concept of intelligent organisations are *uncertainty, information* and *intelligence*.

The usual sources of uncertainty to which organisations are exposed include:

- The occurrence of unexpected external events eg, unpredictable changes in markets, social conditions and environmental factors.
- The occurrence of unexpected internal events eg, unforeseen changes of personnel and a sudden loss of assets.
- Incomplete, inconsistent or unreliable information available to the decision-makers for the purpose of deciding what to do next. This uncertainty may be caused by inadequate information technology or by the speed at which unexpected events occur.

To cope with these uncertainties the last thing that members of an organisation need are precise instructions and rigid lines of command and reporting. They need instead a reasonable freedom to collect relevant information and make appropriate decisions. In this context,

Information is a means of reducing uncertainty about an aspect of the Universe.

And, since no information is ever complete and there always is a residual uncertainty, organisations need individual and collective intelligence, where

Intelligence is the capability of a system to achieve a goal or sustain desired behaviour under conditions of uncertainty.

Simply, Intelligence is a property, which enables an organisation to operate effectively when available information is inadequate. The ability to recognise partially specified patterns is the key to intelligent behaviour and learning is one of its most important manifestations.

"Intelligent behaviour is dependent on the ability of the organisation to quickly comprehend and absorb the changing situation in the business environment and to act on that information. The Intelligent organisation is one that behaves like a living system, it senses and reacts to environmental changes. Thus in an intelligent organisation the implicit knowledge of each learner becomes a building block of the institutional model. Institutional learning begins with the calibration of existing mental models. How much and how fast this model changes will depend on the culture and structure of the organisation. Teams that have to cope with rigid procedures and information systems will learn more slowly than those with flexible, open communication channels" (De Geus A. P.1988).

It is important to remember that in a world in which it is possible to eliminate uncertainty by collecting all appropriate information required for decision-making, there is no need for intelligence or learning. In a stable world that is permanently in a state of equilibrium this is a viable option. Such words do not exist in reality though.

5. PARADIGM SHIFT IN THE DOMAIN OF INFORMATION TECHNOLOGY

Let us consider the main characteristics of a learning organisation and their implications for information systems, one by one.

(1) *Distributed decision making.* At every decision point within organisation there will be a need for relevant information sources and decision support. The client-server architecture with servers supporting decision making centres is capable of fulfilling this aim.

(2) *Evolution of the organisation*. Ever changing organisational structures require systems that are capable of being modified in a cost-effective manner. The obvious configurations for such requirements are networks of intelligent agents capable of decision making by negotiation. At the high end of complexity such network would be capable of exhibiting self-organising behaviour.

(3) *Teamwork.* Supporting groups and teams requires, as the minimum, systems that provide shared scheduling, shared use of documents and shared project management. Further developments are required to provide systems for shared assessment and remuneration.

(4) *Learning, Intellectual Capital and Organisational Memory*. These concepts imply information technology capable of handling knowledge rather than mere data. Organisational Memory requires intelligent systems capable of extracting, storing and refining knowledge as it is being accumulated in an enterprise. For an effective learning there is a need for an interaction with multimedia systems that combine a variety of representations such as text, data, sound, colours, images, animation, video and virtual reality as well as an intelligent support for information retrieval eg, browsers and search engines, multi-agent systems and push-technology.

(5) *Virtual organisations*. Decision making distributed over space and time requires intranets and extranets, web technology, videoconferencing, whiteboarding, virtual reality and email (Rzevski 1996).

The sum total of changes outlined above amount to a fundamental shift from conventional *Data Processing Systems* based on corporate databases and mainframes to *Intelligent Multimedia Systems* based on the Internet, artificial intelligence and a mix of media (Rzevski 1995). To achieve desired synergy between organisational structures and information systems it is necessary to design them concurrently. Any mismatch is known to cause a loss in effectiveness. Intelligent multimedia systems, as characterised above, are particularly suited for learning and sharing knowledge. Legacy systems can be interfaced via Web technology and thus hidden from users. Massive databases can be incorporated into data warehousing systems and searched using data mining technology.

5. CONCLUSIONS

A framework for understanding essentials of learning organisations briefly outlined in this paper allows aligning organisational structures with supporting information systems. Individual and collective intelligence of members of learning organisations must be matched by the artificial intelligence and flexibility of new information technology.

REFERENCES

Argyris C. (1991), Teaching smart people how to learn. *Harvard Business Review*. May-June.

Argyris C. (1994), Good communication that blocks learning. *Harvard Business Review*. Jul-Aug.

Argyris C. (1995), *On Organisational Learning*. Cambridge Blackwell, London.

Babbage, C. (1963). *On the Economy of Machinery and Manufacturers*. Augustus M. Kelley,

New York.
De Geus A. P.(1988), Planning as Learning. *Harvard Business Review*. March-April.
Drucker, P.F. (1992). The new society of organisations, *Harvard Business Review*. Sept-Oct.
Fayol, H. (1949). *General and Industrial Management*. trans. by Constance Storrs. Pitman, London.
Galbraith, J. (1977). *Organisation Design*. Addison-Wesley, Reading, MA.
Gantt, H.L. (1916) *Industrial Leadership*. Yale University Press. New Haven, Conn.
Gilbreth, F.B. and L.M. Gilbreth (1917) *Applied Motion Study*. Sturgis & Walton, New York.
Hammer, M. (1990) Reengineering Work: Don't Automate, Obliterate. *Harvard Business Review*. July-August.
Lawrence P.R. and J.W. Lorsch; Eds. (1970). *Studies in Organization Design.* Richard D. Irwin & The Dorsey Press, Homewood, Ill.
Likert, R. (1961). *New Patterns of Management*. McGraw-Hill, New York.
McGregor, D (1960). *The Human Side of Enterprise*. McGraw-Hill, New York.
Maslow, A (1968). *Towards a Psychology of Being*. D. van Nostrand, Princeton, N. J.
Mayo, G.E. (1933). *The Human Problem of an Industrial Civilization*. Harvard Business School.
Mooney, J.D. and A.C. Reiley (1931). *Onward Industry.* Harper and Brothers, New-York.
Nadler, D.A., J.R Hackman and E.E. Lawler (1979). *Managing Organisational Behaviour*. Little, Brown, and Company, Boston.
Rzevski, G. et al. (1993) Better Ways of Using Information Technology in Manufacturing: Trends. *Proceedings of the CIM - Europe Conference*, Amsterdam.
Rzevski, G. (1995). Intelligent Systems: Issues and Trends. *Proceedings of International Conf on Intelligent Manufacturing*, Wuhan, China.
Rzevski, G. (1996). The Concept of Virtual Design Studio. *Proceedings of the East-West Conference on IT in Design*. Moscow.
Senge P M (1990a), *The fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday.
Senge P M (1990b), The leader's new work: Building learning organizations*". Sloan Management Review*, Fall,
Smith, A. (1987). *The wealth of Nations*. Penguin Classics, London.
Taylor, F.W. (1947). *Scientific Management*. Harper and Brothers, New York.
Tushman, M.L. and D.A.. Nadler (1978). Information Processing as an Integrating concept in Organisational Design. *Academy of Management Review*, 3 (3).
Urwick, L. (1943) *The Elements of Administration*. Harper, New York.
Weber, M. (1946) *Essays in Sociology*. Trans. & ed. by H. H. Gerth and C. W. Mills. Oxford University Press, New York.

COMMAND-AND-CONTROL ORGANISATION	***LEARNING ORGANISATION***
Economy of scale Top-down design Deep hierarchies Vertical integration Individual specialists Functional organisation	Flexibility, agility Evolution Networking Partnerships Multidisciplinary teams Process-oriented units Virtual organisations
Avoidance of uncertainty Precisely specified tasks procedures Predictability	Designed-in uncertainty Empowerment of employees Performance not completely predictable
High power distance Unskilled and semiskilled workforce Detailed job specification	Caring culture Skilled, well educated workforce Learning Intellectual capital Organisational memory Emergent intelligence

TABLE 1 - PARADIGM SHIFT IN THE DOMAIN OF ORGANISATIONAL THEORY

DATA PROCESSING PARADIGM	***INTELLIGENT SYSTEMS PARADIGM***
Centralised information systems Corporate databases Top-down structured analysis & design Data structures Application programs	Networks of PCs. Distributed systems Client-server architectures Evolutionary development Rapid prototyping Objects. Multimedia. Hypertext. Web Intelligent agents Multi-agent systems Emergent intelligence
Local area and wide area networks	Global networks Information superhighways Nomadic personal systems
Business-driven IT strategy Business-driven IT solution	Concurrent development of business and IT strategies Concurrent design of organisational structures and supporting IT Generic packages & systems

TABLE 2 - PARADIGM SHIFT IN THE DOMAIN OF INFORMATION TECHNOLOGY