

INQUIRING ORGANIZATIONS

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ABSTRACT

Churchman (1971) developed five archetypal models of inquiring systems in an effort to expand the field of management information systems along a philosophical path. Contemporary businesses can use the ideas developed by Churchman to become productive and efficient inquiring organisations. This paper explores the relationship between inquiry and learning in organisations and how information technology can be used to support the process of knowledge creation in the context of inquiring systems.

INTRODUCTION

In order for organisations to maintain a competitive edge, they must be capable of continuous learning (Senge, 1990). Learning organisations must have well-developed core competencies, show continuous improvement, and have the ability to fundamentally renew or revitalise themselves. Many authors and researchers are coming forward to describe roles, skills, and tools necessary for the development of learning organisations (e.g., DiBella, 1995; Nevis et al.; 1995; Slater and Narver, 1995; Huber, 1991).

This paper provides a new perspective on learning organisations by viewing them as inquiring systems: systems whose actions result in the creation of knowledge. Churchman (1971, p. 18) recasts the theories of knowledge of philosophers Leibniz, Locke, Kant, Hegel and Singer "in the language and design of inquiring systems," providing "a description of how learning can be designed, and how the design can be justified." Reflections on creating knowledge are shaped and interpreted in the context of designing inquiring systems.

Mason and Mitroff (1973) suggested that Churchman's models of inquiry be used as the basis for creating evidence in the context of management information systems. Hodges (1995, p. 1) believes that the "understanding of the knowledge accumulation process which philosophers have developed throughout the history of human thought is directly applicable to the development of an understanding of knowledge accumulation and use in organisations."

This paper follows the leads of Churchman, Mason and Mitroff, and Hodges, and interprets the Churchmanian inquiring models in the language of the design of learning organisations, or what we call "inquiring organisations." First, we briefly review Churchman's descriptions of archetypal inquiring systems, then we describe epistemology and the concept of learning in organisations. Finally, we employ Churchman's models of inquiring systems to make inferences about the design of inquiring organisations in order to support organisational learning and discuss how information technology is useful in this context.

A REVIEW OF INQUIRING SYSTEMS

Churchman (1971) discusses the writings of philosophers Leibniz, Locke, Kant, Hegel and Singer in the context of inquiring systems. Each of the philosopher's approaches provides for a different way of gathering evidence and building models to represent a view of the world (Mason and Mitroff, 1973). The basic features of each philosophical inquiring system are summarised in Table 1 and elaborated below.

The models of inquiry, being systems, have inputs, processes, and outputs. The output of an inquiring system is "true" knowledge, or at least knowledge that is believed not to be false. One of the most distinctive features of inquiring systems design is the inclusion of elaborate mechanisms for "guaranteeing" that only "valid" knowledge is produced. Such a concept is not new. The "guarantor" in scientific inquiry is generally based on use of the "scientific method," and scientists in general include many checks and balances and usually exhaust a great deal of time and effort to ensure that the results of their inquiries are acceptable to the rest of the scientific community. Each of the approaches described below contain analogous provisions for ensuring that its outputs are consistent with the underlying philosophy, so that the knowledge generated may be considered "valid" for all time.

The Leibnizian Inquirer

A Leibnizian inquiring system is a closed system with a set of built-in elementary axioms that are used along with formal logic to generate more general fact nets or tautologies. The fact nets are created by identifying hypotheses, each new hypothesis being tested to ensure that it could be derived from, and is consistent with, the basic axioms. Once so verified, the hypothesis becomes a new fact within the system. The guarantor of the system is the internal consistency and comprehensiveness of the generated facts.

The Lockian Inquirer

Inquiring systems based on Lockean reasoning are experimental and consensual. Empirical information, gathered from external observations, is used inductively to build a representation of the world. Elementary observations form the input to the Lockean inquirer which has a basic set of labels (or properties) which it assigns to the inputs. The Lockean system is also capable of observing its own process by means of "reflection" and backwards tracing of labels to the most elementary labels. Agreement on the labels by the Lockean community is the guarantor of the system.

	Leibniz	Locke	Kant	Hegel	Singer
Input	None	Elementary Observations	Some empirical	Some empirical	Units and standards
Given	Built-in axioms	Built-in labels (properties)	Space-time Framework Theories	Theories	System of measurement
Process	Formal Logic Sentence generator	Assign labels to Inputs Communication	Construct models from theories Interpret data Choose best model	Construct theses, antithesis Dialectic	Strategy of agreement Sweeping-in
Output	Fact nets Tautologies Contingent truths	Taxonomy	Fact Nets	Synthesis	New standard Exoteric knowledge Simplistic optimism
Guarantor	Internal Consistency	Consensus	Fit between data and model	Objective Observer	Replicability Hegelian over-observer

Table 1. Summary of Inquiring systems

The Kantian Inquirer

The Kantian system is a mixture of the Leibnizian and Lockian approaches in the sense that it contains both theoretical and empirical components. The empirical component is capable of receiving inputs, so the system is open. It generates hypotheses on the basis of inputs received. A clock and kinematic system are used to record the time and space of inputs received.

Perhaps the most unique feature of Kantian systems is that the theoretical component allows an input to be subjected to different interpretations. This occurs because the Kantian theoretical component maintains alternative models of the world (alternative world views). Representations and interpretations are based on causal connections maintained in the models.

The theoretical component contains a model building constituent which constructs Leibnizian fact nets. It tests the alternatives by determining the best "fit" for the data, and the guarantor in this approach is the degree of model/data agreement. The use of alternative models permits, for example, one piece of economic data to be interpreted differently by different econometric models (e.g., competing models proposed by different political parties). Additionally, an "executive routine" turns the Kantian models on and off and can examine their outputs in terms of the degree of satisfaction with their interpretations. Thus, if a model is not producing satisfactory results it can be turned off, while those which are more successful proceed.

The Hegelian Inquirer

Hegelian systems function on the premise that greater enlightenment results from the conflict of ideas. The Hegelian dialectic is comprised of three major players. The first player begins the dialectic with a strong conviction about a fundamental thesis. This player or subject, besides holding a strong belief in the thesis, constructs a view of the world in such a way that information, when interpreted through this world view, maximizes support for the thesis. The second player is an observer of the first subject. The observer generates an opposing conviction to the original thesis. In fact, the observer is "passionately dedicated to destruction of the first subject's conviction" (Churchman, 1971, p. 173). The final player in the Hegelian dialectic is a "bigger" mind and an opposition to the conflict between the thesis and the antithesis. This "bigger" mind synthesizes a new (larger) view of the world which absorbs the thesis/antithesis conflict. Synthesis generated by the objective "bigger" mind acts as guarantor of the system. Objectivity is based on a kind of interconnection of observers (Churchman, 1971, p. 149). They promise that "the movement from thesis-antithesis to synthesis is a soaring to greater heights, to self-awareness, more completeness, betterment, progress" (Churchman, 1971, p. 186).

The Singerian Inquirer

Two basic premises guide Singerian inquiry (Churchman, 1971, 189-191). The first premise establishes a system of measures that specify steps to be followed in resolving disagreements among members of a community. Measures can be transformed and compared where appropriate. The measure of performance is the degree to which differences among group member's opinions can be resolved by the measuring system. A key feature of the measuring system is its ability to replicate its results to ensure consistency.

The second principle guiding Singerian inquiry is the strategy of agreement. Disagreement may occur for various reasons, including the different training and background of observers and inadequate explanatory models. When models fail to explain a phenomenon, new variables and laws are "swept in" to provide guidance and overcome inconsistencies. Yet, disagreement is encouraged in Singerian inquiry. It is through disagreement that world views come to be improved. Complacency is avoided by continuously challenging system knowledge.

Singerian inquiry provides the capability to choose among a system of measures to create insight and build knowledge. A simplistic optimism drives the community toward continuous improvement of measures. However, the generation of knowledge can move the community away from reality and towards its own form of illusion if not carefully monitored.

CONCEPTUAL FOUNDATIONS OF ORGANIZATIONAL LEARNING

To understand how Churchman's inquiring systems can be used to support organisational learning, it is useful to have a fundamental understanding of organisational learning concepts. This section presents organisational learning concepts and is followed by a discussion of how inquiring organisations can utilise information technology to support organisational learning processes.

Epistemology and Learning

Corporate epistemology is the theory of how and why organisations know (von Krogh et al., 1994). Learning is no longer focused on attaining a "right knowledge," but at least three co-existing pieces of knowledge: syntactic knowledge, pragmatic knowledge, and semantic knowledge. Syntactic knowledge pertains to grammar or structure. Pragmatic knowledge relates to the situated context within which learning takes place. Semantic knowledge deals with the meaning of words and symbols. The contest between different elements of knowledge continuously increases the complexity of the total knowledge conveyed (von Krogh et al., 1994).

An organisation's knowledge comes in part from the organisation's employees. "Individuals have private knowledge that can be a basis for organisational knowledge ... Knowledge of the organisation is shared knowledge among organisational members" (von Krogh et al., 1994 p. 59). Individuals have private knowledge that can be an advantage for organisations, because knowledge from various sources contributes to meaning

(White, 1990). Ultimately, knowledge is the assimilation and utilisation of some kind of integrated learning system to support “actionable learning” (Nevis et al., 1995). Creation of a corporate knowledge base allows core competencies to be developed and shared, further allowing actions to be taken that result in incremental or transformational change.

Learning

Learning occurs by improving actions through better knowledge and understanding, encoding inferences from history into routines that guide behaviour, and developing insights, knowledge, and associations between past actions, the effectiveness of those actions, and future actions. It involves the understanding of reasons beyond immediate events. Learning and cognition are highly context dependent. Learning involves the understanding of reasons beyond immediate events.

Learning facilitates behaviour change that leads to improved performance (Fiol & Lyles, 1985; Senge, 1990; Garvin, 1993). While learning can certainly be improved through the use of lessons, lessons are prone to equivocality: the multiple, varied and conflicting interpretations arising from a single source of material. In addition to the use of lessons, learning occurs by improving actions through better knowledge and understanding (Fiol and Lyles, 1985), encoding inferences from history into routines that guide behaviour (Levitt and March 1988), and developing insights, knowledge, and associations between past actions, the effectiveness of those actions, and future actions (Fiol and Lyles, 1985).

Discovery and affirmation (DiBella, 1995) may encourage learners to employ trial and error experimentation or searching mechanisms in order to gain new knowledge. However, structure and organisation (Mayhew, 1992) facilitate learning. Walsh and Ungson (1991) maintain that cultivating and expressly maintaining memory increases learning. They might argue that equivocality reduction is achieved by ensuring the validity of memory. Many dichotomies have been used to describe learning styles. Descriptions of styles are similar, but include subtle differences. Learners can be considered to be adaptive vs. generative, behavioural vs. cognitive, or single-loop vs. double-loop. Adaptive learning styles imply an ability to adjust to correct a given situation. The emphasis in generative learning, however, is an attempt to expand capabilities. Focus on generative learning occurs in order to make transformational changes (Nevis et al, 1995). Learning characterised as behavioural development occurs by adopting new responses and actions, while cognitive development occurs through deeper processing and understanding. Similarly, Argyris and Schön (1978) compare single-loop and double-loop learning. The former is a process that results in a change in factual understanding. The latter attempts to resolve incompatible norms by setting new priorities and weighing norms.

Learning is considered to be low-level when a given set of rules is followed producing consequences for a particular behaviour (Argyris and Schön, 1978). It is a result of repetition and routines and involves association building. Single-loop learning maintains central features or sets of rules. Learning at low-levels is restricted to simple error detection and correction. High-level learning is more consistent with double-loop learning in that it aims at adjusting overall rules and norms. The desired consequence is the development of frames of reference and interpretive schemes of cognitive frameworks. High level learning develops an understanding of causation. Multi-level learning mixes elements of low-level and high-level learning. Multi-level learning occurs when frequently used procedures and specific rules are used to develop competency and understanding (Levitt and March, 1988). Multi-level learning produces increasing returns to experience via the persistent use of procedures or technologies. Multi-level learning is susceptible to competency traps whereby superior procedures are ignored once an inferior procedure or technology is learned and used repeatedly.

Finally, learning can be considered from the perspective of learning frameworks, learning sources, and developmental orientation. Shanks (1995) describes a framework for organisational learning which produces results at three levels: procedural, which engenders continuous incremental improvement; architectural, which attempts to change how work is done; and strategic, which represents change in or reinvention of the business. White (1990) emphasises that knowledge from various sources contributes to meaning. Syntactic knowledge has to do with grammar or structure. Pragmatic knowledge involves the situated context within which learning takes place. Semantic knowledge deals with the meaning of words and symbols. Four levels of professional development can be transferred to the context of inquiring organisations. An apprentice is able to understand and apply basic concepts. Apprentices move from rote memorisation to understanding on their way to becoming specialists. Analysis allows a specialist capable of doing independent work, to move into the generalist realm and to integrate knowledge (possibly across disciplines), creating links between previous unrelated items of information. As a generalist moves toward the renowned, learning becomes synthesis and new knowledge is created.

Organisational Learning

Organisational learning is the development of new knowledge and insights that have the potential to influence behaviour (e.g. Fiol & Lyles, 1985; Huber, 1991; Slater and Narver, 1995). When members of an organisation share associations, cognitive systems, and memories, organisational learning is taking place. Learning by organisations relies on the people and groups as agents for the transferral of knowledge. Over time, what is learned is built into the structure, culture, and memory of the organisation. Lessons (knowledge) remain within the organisation even though individuals may change. Shanks et al. (1995) theorise that organisational learning improves performance, enhances value, and creates new beginnings. He argues that well designed learning programs improve mental models, facilitate effective analysis, forge commitment, and open senses to the real world.

DiBella (1995) makes a case for understanding learning organisations using normative, developmental, and capability perspectives. The normative view, typified by Senge (1992) and Garvin (1993), supports the notion that learning is a collective activity that only takes place under a certain set of circumstances. There is a focus on traits or processes that must be present to ensure learning. This perspective requires some form of managed leadership in order to achieve learning. The developmental perspective considers evolutionary changes and learning through on-going interpretations of experience. Organisations pass through developmental stages in order to learn. This is consistent with models presented by Nevis et al. (1995) and Huber (1991), which sort learning into knowledge acquisition and assimilation, dissemination and sharing, and utilisation. Another view describes developmental learning as movement from rote memorisation to understanding of concepts, integration of ideas, and finally synthesis of new ideas. A capability perspective posits that there is no one best way for organisations to learn. According to this perspective, learning processes are embedded in organisational structure and culture. Learning occurs through self-discovery and reaffirmation. As new models are presented to the system, it considers where they fit and revises its world view accordingly.

INQUIRING ORGANIZATIONS

Inquiring organisations are learning organisations modelled on the theories of inquiring systems. The first maxim for inquiring organisations is that their actions should be based on valid knowledge. Yet organisations faced with the dynamic, and often hostile, environments of today may not have the time nor the resources required to validate knowledge in the scientific sense. Moreover, beliefs that were valid yesterday may no longer hold in rapidly changing organisational environments that are socially constructed and subject to change by many forces. Thus, while an inquiring organisation should take reasonable and prudent steps to ensure that its actions are based on valid knowledge, in many cases, the only reasonable guarantor is a Lockean type of consensus among its members. This assumption would appear to be a potentially fruitful research area, as validation of knowledge for inquiring organisations seems to be substantially different from validation of knowledge in scientific inquiring domains.

Learning is clearly a fundamental aspect of the inquiring organisation, and a well-designed learning subsystem is critical to its success. As indicated previously, organisations must develop core competencies, improve continuously, and fundamentally renew or revitalise themselves. Churchman's descriptions of inquiring systems can be applied to enhance an organisation's ability to achieve success in these areas. The roles of inquiring systems in creating inquiring organisations are briefly described in Table 2 and elaborated below.

Leibnizian-Based Inquiring Organizations

The Leibnizian inquirer learns by using formal logic to make inferences of cause and effect. A Leibnizian system in an inquiring organisation would rely on the theory of autopoiesis for its existence. The theory, taken from cell biology, maintains that the components of a system are used to produce new components and their relations, so as to recreate the system. Everything that the system needs for its reproduction is already in the system (von Krogh et al., 1994). Leibnizian systems are created in a recursive, self-generating, closed and autonomous manner. Being a closed system, it only has access to knowledge generated internally.

An application of the Leibnizian approach may be observed when the policies, goals, ideas of purpose, and core values, established by the organization's designers, serve as Leibnizian axioms. "Truth" is determined in a procedural manner, with focus on structural or procedural concerns, and with error detection and correction being a direct consequence of comparing inputs with the accepted "axioms" of the system (i.e., organization). The organization's basic theorems, so defined, must be mutually consistent, lending themselves to rote memorization

and direct application. Furthermore, new ideas, plans, and visions, (i.e., hypotheses) developed within the organization must be compatible with the existing policies, goals, and core values of the organization. As creative tension is exercised to bring the organization closer to its vision, this test of consistency must be continuously reviewed.

A consequence of Leibnizian inquiry may be the creation of what Fiol and March (1985) refer to as competency traps; as learning produces increasing returns to experience via the persistent use of procedures or technologies, superior procedures or technologies are ignored once an inferior technology is learned and used repeatedly. If several "generations" of procedures or technologies have been ignored, conversion to the newer approaches may become more costly and difficult. The gap between employees' existing skills and skills needed for new approaches may cause retraining to be difficult.

Lockean-Based Inquiring Organizations

A community of Lockean inquirers learns by observing the world, sharing observations, and creating a consensus about what has been observed. The organisation's culture or subculture (a Lockean community) determines the nature of learning and the way in which it occurs. Equivocality refers to the multiple, varied and conflicting interpretations about an organisational situation. The Lockean inquirer attempts to reduce equivocality by building consensus among team members. Agreement by Lockean communities helps to establish new direction, agreement, and organisational knowledge.

The Lockean inquirer is able to support both adaptive and generative learning. Lockean systems are open to outside influences and have no built-in preconceptions of the world. These characteristics enhance the firm's generative learning by fostering new ways of looking at the world and preventing rigid adherence to existing standards and ideas. By accepting observational inputs without a biased view, the Lockean inquirer may more clearly see, not only how events occur, but also the systems which control the events. This is critical information to facilitate generative learning. The Lockean system, with its ability to observe its own process and trace back any label to the most elementary set of labels, supports this need.

An application of the Lockean approach is demonstrated in a "needs assessment" exercise in which, for example, an organization's managers decide the characteristics needed in a new hire. While complete agreement may not be possible, consensus may be reached at least to the point that an effective advertisement may be created and a search process begun so that a new employee may be identified who embodies the generally agreed upon skill set needed by the organization.

The Lockean concept of consensual agreement in or between systems enhances the ability of the learning organization to develop a shared vision. Examination of causal relationships also enhances understanding, thereby moving the participants in a Lockean approach from apprentice-like rote memorization of procedures to a level of specialist understanding and perhaps on to generalist integration. By observational input and inductive labeling, the Lockean inquiring system is also able to improve the firm's picture of current reality. These two factors, a shared vision and agreement on current reality, are necessary ingredients for creative tension.

An inability to reach consensus, however, marks failure for the system. In this case, decision-making processes may be unacceptably delayed or impossible to complete. In highly emotional or divisive decision-making situations, a Lockean approach may not be suitable due to the reduced likelihood of achieving consensus.

	Leibniz	Locke	Kant	Hegel	Singer
System	Closed	Open	Open/Closed	Open	Open
Learning Style	Behavioural Adaptive Single Loop	Consensual Generative	Cognitive Generative	Generative Double-loop	Generative Double-loop
Learning Mechanism	Simple error detection and correction	Reduction of Equivocality	Knowledge scan Model matching Recursiveness	Synthesis by objective mediator	Trial and error Agreement and partition
Learning Level	Low	High	Multi-level	High	Multi-level
Learning Framework	Procedural	Strategic Architectural	Procedural Architectural	Architectural	Procedural Strategic
Learning Source	Syntactic	Pragmatic	Pragmatic Semantic	Semantic	Syntactic Pragmatic
Learning Orientation	Normative	Developmental Capability	Developmental Capability	Developmental	Developmental
Developmental Orientation	Apprentice	Specialist Generalist	Specialist Generalist	Renowned	Renowned
Obstacles	competency traps incorrect inferences about cause and effect	Failure to reach consensus	Competency traps Lack of fit between tasks and goals	Learning disconnected from purpose	Complacency Incorrect standards Lack of oversight

Table 2. Properties of Learning Associated with Churchmanian Inquiry

Kantian-Based Inquiring Organizations

Recognizing that knowledge is time variant, a Kantian system of inquiry constantly scans internal and external environments for purposeful knowledge. The recursive nature of the Kantian inquirer suggests that new knowledge is created from existing knowledge. Environmental scanning and creating knowledge from existing knowledge give the Kantian approach characteristics of both closed and open systems. The search for alternate representations, basic to a Kantian inquiring system, is a form of generative learning.

Kantian inquiry acknowledges that inputs received from various knowledge sources may have different interpretations. The Kantian inquirer is able to use explicit knowledge and tacit knowledge (i.e., hunches, intuition, experience, insights) to consider the many interpretations of inputs. Incoming knowledge is compared to organizational memory allowing the inquirer to consider ways to create and incorporate new knowledge. By considering associations between extant knowledge and new information, the Kantian inquirer establishes new world views.

An application of the Kantian approach can be seen in market testing of new advertising campaigns. Different advertisements, exploiting different types of cues, are often tested to determine which advertising approach generates the best response. Each advertisement alternative provides a different model to be evaluated.

Ultimately, one (or perhaps a few) advertisements are selected for general use based on responses from the test subjects. Simultaneously, the company represented in the advertisements and the marketing agency producing the advertisements has an opportunity to learn about the product market.

Failure in a Kantian system occurs when no fit exists for the input data in the alternative models or when one model is used repeatedly due to a history of good fit with the data. In the former case, no model emerges as superior and decision-making processes will be stalled. In the latter case, the same competency trap issues emerge as described earlier in a Leibnizian approach.

Hegelian-Based Inquiring Organizations

Hegelian synthesis of two opposing models into a new world view is the epitome of an open system and generative learning. Hegelian organizations rely upon the dialectic to resolve diametrically opposing viewpoints, the thesis and antithesis. In the Hegelian component of an inquiring organization, arbitration is used to evaluate and synthesize contributions from opposing viewpoints resulting in a larger mind which absorbs the thesis/antithesis conflict. Knowledge gained through Hegelian inquiry may result in an entirely new strategic direction for a given organization, as Mason (1969) has shown in his work on dialectical planning systems.

The concept of vision versus current reality in a learning organization may be represented by the broad perspective of the observer and the narrow world views of the thesis and the antithesis. In other words, creative tension is analogous to the force which drives the dialectic toward synthesis.

An application of the Hegelian approach can be seen in the arbitration of employment contracts. The most visible example might be salary and benefit disputes between employers and trade unions. Each side of the dispute is representative of the thesis and antithesis. An objective observer is brought in to help promote dialogue and find overlap in the opposing views. Eventually, the overlapping views result in an arbitrated agreement between the parties. Another example is provided by managerial debate about forecasts. Honest debate regarding the meaning of various economic indicators, for example, and their related cause and effect issues, would be representative of Hegelian inquiry, assuming the new world view is attained. Note that Hegelian inquiry depends on synthesis of opposing viewing presenting a win/win scenario to the organization. In contrast, solutions which offer compromise reflect a lose/lose scenario to participants.

Dialectic cannot exist without dialogue. In addition, the Hegelian system will fail when learning is disconnected from the purpose of the dialectic debate. As discussed by Hodges (1991):

“To understand a statement, it must be interpreted in some context of meanings. In isolation, a statement has no intrinsic truth. Contexts of meanings may be built around any statement, including a thesis and antithesis. Each is given its true value by its own context of meanings. When the contexts of meanings overlap, a process of translation becomes possible, i.e. the synthesis. If finding the overlapping of meaning was not possible then not only would the thesis and antithesis be contradictory, but their contexts of meanings would be contradictory as well. The latter would in fact be two mutually exclusive worlds.”

Singerian-Based Inquiring Organisations

The Singerian organisation has the purpose of creating knowledge for choosing the right means for one's end. Knowledge must be connected to measurable improvements. Measures of performance are judged not only by organisational standards, but also by what is good for all of society. A company has to know the kind of value it intends to provide and to whom. Knowledge is generated to be useful for all. In this regard, Singerian organisations model contemporary management trends where employees are empowered to contribute in the decision-making process. Working environments stress cooperation with fuzzy boundaries where teamwork and common goals are primary driving forces. Anyone may act as designer and decision-maker.

Applications of Singerian inquiry are evident in standards making bodies such as IEEE and ISO. Organisations that use metrics as a measure of performance are constantly searching to create and modify existing models. Marketers consider models of consumer behaviour, operations management simulates newer, more efficient production facilities, and computer chip manufacturers search for faster processors and methods for utilising greater processing capabilities. Rapidly advancing technologies create impetus for Singerian organisations to constantly monitor and update methods and models for conducting business. Finally, a Singerian organisation keeps one eye turned to the needs of society to measure what is possible against what is good for humankind.

IT SUPPORT OF INQUIRING ORGANIZATIONS

Having merged Churchman's inquiring system descriptions with learning characteristics, we are now in a position to offer suggestions regarding information technology (IT) support for the inquiring system processes described

above. Table 3 presents a summary of these suggestions.¹ Organisations may employ one or many of these methods of inquiry.

Technological changes and shifting demands make rapid learning essential in organisations. The advent and increasingly wide utilisation of wide area network tools such as the Internet and World Wide Web provide access to greater and richer sources of information. Local area networks and intranets give organisations a way to store and access organisation specific memory and knowledge. Used effectively, these tools support the notion of learning in organisations. Coupled with the constructs described in this paper, they help support the notion of inquiring organisations. We describe more general aspects of IT support for each of the methods of inquiry below.

IT Support for Leibnizian Inquiry

Leibnizian inquiring organisations are essentially closed systems. They do not accept inputs from outside sources. However, they are still capable of “learning” by using formal logic to create knowledge. Many expert systems operate with a static set of rules. Interrogation of the system results in suggested course(s) of action for problem resolution. Unlike a database, an expert system can draw upon its rule base to make inferences. Some of these systems “learn” by updating the knowledge base as new situations are encountered.

Organisations employing Leibnizian inquiry rely heavily on standard operating procedures and formal instruction mechanisms. Computer operations, machine shops, and assembly lines are examples of systems within an organisation with characteristics that lend themselves to Leibnizian knowledge creation. Rule-based expert systems are easily employed in such environments.

IT Support for Lockean Inquiry

The goal of Lockean inquiry is consensus among members of a decision community. In organisations, consensus may be reached by disseminating information among decision-makers with solicitation for feedback, and compilation of results. Formal and informal gatherings are often held to iron out any differences.

Several technologies have been developed to support consensus building among team members. Information technologies, which aid Lockean decision-makers, include Group Support Systems (GSS), Computer-Supported Cooperative Work (CSCW), Computer Networks, and Distributed Databases. These technologies provide mechanisms to bring decision makers together, giving them access to information on-line to support the decision making process. Some of these systems allow anonymous participation to encourage non-biased and unencumbered input.

Lockean inquiry can be used to help define a problem or elements of a task. Inputs are classified according to given properties (Locke calls this process “labelling”). Participants in Lockean inquiry make observations about the problem or task and develop methods to solve the problem or carry out the task.

Lockean inquiry classifies aspects of the task domain allowing decision-makers to decompose the problem and build a solution by reaching agreement. Within organisations, Lockean inquiry is exhibited when members of the organisation are brought together to perform a task or solve a given problem. Unlike Hegelian inquiry, synthesis of a new solution is not necessarily required. Decision-makers may only need to agree on an existent option (e.g. where they are going for lunch).

¹ The boundaries drawn in Table 3 do not form discrete categories. Properties described in the table may in fact overlap between forms of inquiry. Similarly, forms of inquiry may overlap between functional levels within an organization.

	Leibniz	Locke	Kant	Hegel	Singer
Input	None	Goals, decisions, standards, policies, and procedures)	Knowledge Sources Organisational Memory	Mission Statement	Units, Standards
Given	Standards Operating Procedures Rule base	Organisational history Organisational structure and culture	Tacit knowledge Explicit knowledge Working theories	Opposing Views	System of Measures
Process	Cause and effect analysis Inference Systematic problem solving	Negotiation Communication Consensus building	Knowledge scanning Association building Recursive learning	Arbitration	Sweeping-in variables to overcome inconsistency
Output	Simple error detection and correction Suggested course of action	Equivocality Reduction	Integrated, timely knowledge	Conflict resolution Renewal Enlarged perspective New strategic direction	New measures Exoteric knowledge
IT Support	Expert Systems	Database GSS Networking	Internet Knowledge Base Model Base	GSS Dialectron	CASE Expert systems WWW Objects

Table 3. Summary of IT Support of Inquiring Organisations

IT Support for Kantian Inquiry

A Kantian inquirer compares what is known with new inputs. Learning occurs in the Kantian inquiring organisation when inputs are fit into existent models creating new perspectives and generating additional context for decision making. Organisational memory plays an important role in Kantian inquiry because it provides the model bases and knowledge structure with which inputs are compared. Knowledge from a Kantian perspective is dynamic by virtue of changing environments and solution requirements.

Kantian inquiry may be viewed as a method for interpreting inputs to provide direction. In organisations, middle management is responsible for interpreting inputs from upper management and providing direction for lower level organisational members. Middle managers use the resources at their disposal to determine how best to fit

tasks into the ongoing operations of the organisation. Executive Information Systems, Decision Support Systems, and Group Support systems that employ organisational models and knowledge sources (e.g., data warehouse, corporate databases, etc.) illustrate ways in which Kantian inquiry could manifest itself in learning organisations. Corporate intranets and newsgroups are a rich resource for comparing current issues with past decisions.

IT Support for Hegelian Inquiry

Hegelian inquiry in organisations has little structure or formal mechanisms to guide it. Group support systems that include negotiating and arbitration elements assist organisations in Hegelian inquiry. Applegate et al. (1987) developed PLEXSYS, a sophisticated planning system, to facilitate idea generation, idea structuring and analysis, and choice of alternative solutions to problems. Conklin and Begeman (1988) designed gIBIS (graphic Issue Based Information Systems) to facilitate argumentative dialogue among stakeholders in order to help them understand the specific elements of each other's proposals. Mason (1969) demonstrates strategic planning as another example of Hegelian inquiry within organisations. Hodges' (1991) Dialectron system can manage the dialogue necessary to generate synthesis between problem domains incorporating thesis and anti thesis. Dialectron's architecture results from combining concepts from several works: Rescher's (1977) characterisation of dialectic as two parallel disputations, and his inventory of moves and countermoves; Ackoff's (1981) concept of interactive planning; Axelrod's (1976) cognitive mapping technique; and Mitroff, et al.'s (1970, 1971) mathematical model of the dialectic process. The design follows an extensive exploration of the dialectic process. It is capable of supporting two opposing models of the same phenomena, thereby facilitating the dialectic process.

IT support for Singerian Inquiry

Systems and organisations that use metrics practice Singerian inquiry. Accounting systems are perhaps the sine qua non of measurement, as every enterprise must have one. However, accounting systems measure only the financial health of the firm. To understand and explain the organisation fully, it is necessary to "sweep in" variables from a wide variety of sources both inside and outside organisational boundaries. Managers in a Singerian organisation should develop measurement standards, continuously compare organisational performance to those standards, and modify models of performance as is required to achieve the standards.

Numerous examples of metrics exist in information technology. Telecommunications standards, reuse libraries, code generators, objects and software metrics all incorporate standards and systems of measurement. The metrics and standards are constantly evolving due to the rapid pace of emerging and improving technologies. Organisations who become complacent can loose in a competitive marketplace. Other organisational elements that fit a model of Singerian inquiry include training offices and marketing departments. Training provides a forum for creating and measuring knowledge necessary for work-place activities. Marketing departments assign and evaluate sales quotas used to measure the success of organisational members.

The Internet and World Wide Web serve as resource and dissemination agents for Singerian inquiry. During the sweeping-in process, inquirers are able to use the web to gather and assimilate information that helps refine variables and reduce inconsistencies in the system of measurement. Once defined, new measures and standards can be posted to the web and distributed to all interested parties. In this way, the exoteric knowledge goes forward to be useful "for all men in all societies" (Churchman, 1971, p. 200).

SUMMARY

To be successful, the modern organisation must be capable of continuous learning. Churchman's inquiring system models provide the basis for a new perspective on learning organisations. Examining organisations from the point of view of inquiring systems reveals the need for a guarantor of knowledge in learning organisations. A learning system constitutes the core of the learning organisation. By exploring models of inquiry, learning organisations can gain insight into how learning systems may be designed. Ways in which information technology may be used to support inquiring organisations have been suggested.

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