HOW INTERPRETING BUSINESS PRINCIPLES THROUGH THE LENS OF "NEW SCIENCE" CAN HELP SOCIAL ORGANIZATIONS RESPOND TO GLOBAL AND LOCAL THREATS AND OPPORTUNITIES WHILE PROTECTING THEIR GOALS AND VALUES: A HEALTH CARE EXAMPLE OF SCIENTIFIC HUMANISM, COMPLEXITY, AND IMPLICATE ORDER

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Abstract

Canadian governments and their publically-funded health authorities are under increasing pressure to provide timely and quality services to a growing and aging population. They are also expected to use business principles and tools to make the health care system more efficient and to reduce costs through innovation and change. Business principles such as strategic planning, process re-engineering and improvement, balanced scorecards for performance measuring and reporting, and systems design and optimization are based on scientific concepts that can be traced back through Taylorism of the early 1900s to the Industrial Revolution to early discoveries in mathematics and physics. As well as employing science-based business practices in order to increase the efficiency of the health care system, health care leaders must also employ social values in order to be patient-centered. These social constructs are based on humanistic versus mechanistic principles. How, then, can the health care system achieve its social goals if the business principles it has come to rely on may actually be contrary to its patient-centered values? Viewing health care leadership and management through the lens of "New Science" can help reconcile these seemingly contrary philosophies. "New Science" takes scientific management concepts beyond Newton, Taylor, and Einstein and employs a systems and ecological view of life in health care organizations. "New Science" goes beyond quantum mechanics and includes uncertainty and unpredictability, complementarity, semantic and chaotic infinite complexity, non-linear adaptive feedback networks, and wholeness and implicate order.

Keywords: "New Science" Business Healthcare

Introduction

The purpose of this paper is to use "New Science" as a lens through which to view the business principles required for meeting the innovation and change challenges in Canadian health care and to determine in what ways "New Science" can help make sense of these challenges. These challenges are in response to new realities, to new knowledge, and to increasing demands for improvements from the organization's internal and external environments. The paper includes literature on organizational theory and its scientific beginnings and literature explaining "New Science" theory, complexity theory, and chaos theory. The review then addresses literature on the organizational elements of "New Science" including complementarity, uncertainty, and wholeness and implicate order.

Organizational theory and science

Capra (1982) described how science and Sir Isaac Newton's theory of the universe and the belief in the rational approach to human problems in the eighteenth century were central to the "Age of Enlightenment" (p. 68). The logically empirical and linear solutions provided by Newton's science found their way into the scientific management of many different types of organizations, including many business and management practices used daily by Canadian health administrators. Promoters of the science of administration claimed to have found a rational basis for human decision-making and a value-free technology for increasing the effectiveness and efficiency of organizations (Greenfield, 1986). The challenge for Canadian health care organizations and administrators is to determine how to apply science-based business principles as they strive for productivuty improvement through innovation and change while protecting their patient-centered social principles upon which their missions, visions, and values are based.

Science has now progressed well beyond Sir Isaac Newton. The discovery of evolution in biology forced scientists to abandon the "Cartesian" (Capra, 1982, p. 57) conception of the world as a machine. Instead, the universe had to be viewed as an evolving and ever-changing system in which complex structures developed from simpler life forms. Evolutionary concepts also emerged in physics. However, whereas in biology evolution meant a movement toward increasing order and complexity, in physics it came to mean just the opposite – a movement toward increasing disorder; something the laws of thermodynamics addressed with the concept of entropy.

Although physicists debated when they replaced Newton's concepts of gravity with Einstein's principles of relativity, physics may now be converging on what the science refers to as a "unified field theory of everything" (Greene, 2003, p. 16). This area of science is called "New Science". "New Science" includes the concepts of quantum mechanics, complexity theory and chaos theory, uncertainty and probability, order and disorder, indeterminacy and unpredictability, complementarity and relationships, string theory, multi-dimensions, and interconnectedness. Complex, uncertain, and unpredictable and relying on complementary and interconnected relationships describes well the Canadian health care environment.

The science of Copernicus, Descartes, Locke, Bacon, and Newton were applied to management and administrative theories by authors and practitioners such as Taylor, Simon, and Halpin (Greenfield, 1986). Similarly, the philosophies of the "New Science" can be used to help discover how organizations work, how organizations can change, and how organizations can be simplified (Wheatley & Kellner-Rogers, 1996). The metaphors provided by the philosophy of "New Science" can help one understand both resistance to change and the novel new order that can emerge through chaos and unpredictability. Few public sector, or, indeed, private sector organizations are under pressure to change and to use mechanistic business principles to produce efficiencies and cost savings as are health care organizations.

Defense of a New Science

Canadian health care has as its primary purpose the care and health of people and the community. Despite this humanistic mandate, health authority administrators are required to use evidence- and objective-based scientific management and business methodologies and tools on a daily basis. Much has been written against the use of these modernist, positivist, and scientific management concepts in administration (Dolmage, 1992; Greenfield, 1993; Kendell & Byrne, 1977). "New Science", however, may suggest ways in which new scientific metaphors might address some of the scientism and humanism concerns raised by authors of critical theory and postmodernism, which may help inform the "business" of health care.

When describing the evolution of the philosophy of science, and how post-Enlightenment scientism and modernism has created many concerns about the human condition, postmodernists used a definition of science limited to Newtonian-based linear mechanisms. It is this apparent conflict between the mechanistic business principles that drive certain aspects of health care administration and the fundamental humanistic raison dètre of health care that can be reconciled with "New Science".

"New Science" includes the concepts of quantum theory and beyond. Bohm (1980) argued that quantum theory is the most basic way available in physics for understanding the fundamental and universal laws relating to matter and its movement. It must be given serious consideration in an attempt to develop an overall worldview. In quantum theory, there is no consistent notion at all of what the reality may be that underlies the universal constitution and structure of matter. If we try to use the prevailing worldview based on the notion of particles, we discover that the particles, such as electrons, can also manifest as waves, that they can move discontinuously, that there were no laws at all that apply in detail to the actual movements of individual particles and that only statistical predictions can be made about large aggregates of such particles. If, on the other hand, we apply the worldview in which the universe is regarded as a continuous field, we find that this field must also be discontinuous, as well as particle-like, and that it is undermined in its actual behavior as is required in the particle perspective of relation as a whole (Bohm).

"New science" and complexity theory

Health care organizations are large and complex organizations. Biggiero (2001) distinguished between difficulty and complexity in organizations. Difficult problems are those which require time, hard work, dedication, skills, information, and effort. Complex problems, according to Biggiero, are different. Biggiero's different types of "observed irreducible complexity" (p. 3) are summarized in the following table:

Classifications of observed irreducible complexity

	Trans-Computational	**Infinite**	**Logical**
Quantitative (syntaxical)	Computational	Chaotic	Logical
Qualitative (semantic)		Intuitive, spiritual knowledge and the meaning of words	Relational

Chaotic complexity can be observed, quantified, and ordered; intuitive, spiritual, and semantic complexity can not be, it is subjective and contextual (Biggiero). Health care organizations must strategically, managerially, and administratively deal with all forms of complexity.

The science of complexity studies the fundamental properties of non-linear feedback networks and complex adaptive networks (Stacey, 1996b). Complex adaptive systems consist of a number of components, or agents, that interact with each other according to sets of rules that require them to examine, and to respond to, each other's behavior in order to improve their behavior and the behavior of the system they comprise. Stacey argued that such systems operate in a manner that constitutes learning. Because those learning systems operate environments and consist mainly of other learning systems, it follows that together they form co-evolving supra-systems that create and learn their way into the future (Stacey).

Lessons for Complex Change

Complex health care organizations are in a constant state of chaotic change as they strive continually for efficiencies and service improvements through innovation and process re-engineering supported by business concepts such as key performance measurement, return on investment analysis, and business planning. Organizations change when logical

instrumental-technology rationality rules slowly make room for subjectivism and hope (Kincheloe & McLaren, 2000). Fullan (1999) stated that organizational change is complex and that theories of change and theories of education need each other. Understanding the meaning of operating on the edge of chaos is critical to understanding change, and emotional intelligence is both anxiety provoking and anxiety containing (Fullan).

Complexity Theory and Moral Purpose

There are few organizations that are as complex or that have a higher moral purpose than a health care authority caring for ill patients and the wellness of their communities. Fullan (1999) provided insights into complexity combined with moral purpose that included complexity and the change process; the deep meaning of inside and outside collaboration; the complexities of transferability; and intellectual, political, and spiritual fusion. The new science of complexity claims that the link between cause and effect is difficult to trace. Change, planned and otherwise, unfolds in non-linear ways. Paradoxes and contributions abound and creative solutions arise out of interaction under conditions of uncertainty, diversity, and instability (Fullan).

Health care organizations are expected to adapt to internal and external threats and opportunities in order to improve service and health outcomes and to slow the increase in costs. According to complexity theory, adaptation is most effective in systems that are only partially connected. The argument is that too much structure creates gridlock, while too little structure creates unbounded chaos. Brown and Eisenhardt (1998) argued that "complexity theory began with an interest in how order springs from chaos" (p. 14). Health authorities need to determine how to live on this chaos boundary: unbounded chaos may impact patients negatively while too much structure would be seen as public sector bureaucracy and inefficiency.

"New science" and chaos theory

Health care administrators must understand the chaotic and complex nature of their organizations. Wheatley (1999) described chaos containing order as an essential, nourishing element of systems that fall apart. The layers of complexity and the sense of things being beyond our control and out of control are but signals of our failure to understand a deeper reality of organizational life and of life in general (Wheatley).

Chaos theory has shaken science to its foundations with the realization that very simple dynamic rules can give rise to extraordinarily intricate behavior (Waldrop, 1992). Complex systems can acquire the ability to bring order and chaos into a special kind of balance.

The balance point, often called the edge of chaos (Fullan, 1999; Waldrop, 1992) is where the components of a system never quite lock into place, and yet never quite dissolve into turbulence either. The edge of chaos is where new ideas and innovative genotypes are forever nibbling away at the edges of the status quo and where even the most entrenched old guard will eventually be overthrown (Fullan). The edge of chaos is the constantly shifting battle zone between stagnation and anarchy, the one place where a complex system can be spontaneous, adaptive, and alive.

Sullivan (1999) described chaos theory and the change process that can transform an organization into a new order. Health care organizations need intuitively to feel the simple small changes within them and to apply gentle creative action in the appropriate places to effect change. Chaos theory tells us that the obvious or expected place to attack a problem may not always be the most effective (Sullivan). The art of instigating organizational change becomes not the heavy-handed directive approach. Rather, change in an organization can be

implemented by studying the self-renewing and the self-transcending dynamics that are operating on particular aspects of the organization.

Chaos theory and its application to organizational complexity can be an important theory for health care organizational and business leadership and for bounding chaotic disorder and unpredictable change forces in health care organizations.

Chaos Theory and Leadership

Many aspects of health care leadership are based on traditional business concepts grounded in cause-and-effect and objective science. "New Science" suggests a new approach to health care leadership. Rost (1991) described how the construct of leadership is illuminated by chaos theory. Leadership is not limited to the leadership behaviors of a key position holder or team of top people. Leadership is conducted throughout the organization, through all its agents. Leadership is broadly conducted precisely because in chaotic systems, all agents have potential access to vital information from the environment. Though leadership is broadly distributed, it is specific in function.

Therefore, organizational leaders should not focus on operational, objective, and day-to-day problems (Burns, 2002). Burns argued that transporting the values underpinning "New Science" philosophical foundations throughout an organization via language and listening ought to be the prime purpose of these leaders. Indeed, the leadership function, as a defined functional box on an organizational chart, should disappear. Ordering disorder and simplifying semiotic, semantic, relational, and chaotic complexity (Biggiero, 2001) can happen throughout the organization. Centralized and top-down management is not required (Burns). This requires a new approach to leadership in health care organizations.

"New science" organizational elements

"New Science" has developed from new descriptions and interpretations of quantum mechanics. Quantum principles require us to fundamentally change our relationship to measurement and observation (Wheatley, 1999). If quantum matter develops a relationship with the observer and changes to meet his or her expectations, then how can there be scientific objectivity? If one structures an experiment to study wave properties, matter behaves as a wave. If the experimenter wants to study particles, matter obliges and shows up in particle form. The act of observation causes the potentiality of the wave packet to collapse into one or the other aspect. One potential becomes realized while the other instantly disappears. Before the observer acts, an endless profusion of possibilities continues to be available. Once the observer chooses what to perceive, the effect of perception is immediate and dramatic. All the wave functions representing the observed system collapses, except the one part, which actualizes into reality (Zukav, 1979).

The quantum theories of waves and particles and of the perceptions and impact of the observer or the participant are explained in a few fundamental "New Science" concepts. These concepts are complementarity and uncertainty, organizational fields and forces, and wholeness and implicate order.

Complementarity and Uncertainty

"New Science" includes the important quantum principles of complementarity and uncertainty. Matter can appear as particles (specific points in space) or it can show up in waves (energy dispersed over a finite area) (Bohm, 1980; Heisenberg, 1999; Wheatley, 1999). Matter's total identity includes the potential for both forms – particles and waves. This is Bohr's "Principle of Complementarity" (p. 36). Wheatley described "Heisenberg's Uncertainty Principle" (p. 37) where one can measure the particle aspect or the wave aspect of matter – either location or movement. One can never measure both at the same time. Thus,

while one can measure wave properties, or particle properties, the exact properties of the duality itself must always elude any measurement one may hope to make.

Wheatley (1999) argued that a quantum perspective provides one powerful explanation of Newtonian empirical and linear beliefs. If there is no objective reality out there, then the environment and our future remain uncreated until we engage with the present. We must interact with the world in order to see what we might create. Through engagement in the moment, we evoke our futures. To live in a quantum world, to weave here and there with ease and grace, we need to change what we do (Wheatley). Change and innovation designed to produce efficiencies and improved health outcomes define current Canadian health care.

Wholeness and Implicate Order

Unbroken wholeness in organizations is "implicate or enfolded order" (Bohm, 1980, p. 188). Bohm used the term "implicate" (p. 188) to describe the intimate and entangled connections between people in organizations. Intimate and entangled relationships describe well the health care environment. In the enfolded order, space and time are no longer the dominant factors determining the relationships of independence or dependence of different elements. Rather an entirely different sort of basic connection of elements is possible from which our ordinary notions of space and time, along with those of separately distinct material particles, are extracted as forms derived from the deeper order. These ordinary notions in fact appear in what is called the explicit or unfolded order, which is a special and distinguishable form contained within the general totality of all the implicate orders (Bohm). Implicate order describes how randomness and instability in organizations can become ordered through the intimate, entangled, and enfolded relationships and connections between the people within it.

What is needed in organizations is an act of understanding in which we see the totality as an actual process that, when carried out properly, tends to bring about a harmonious and orderly overall action in which analysis of parts has no meaning (Bohm, 1980). In quantum physics, a homologous process is described as relational holism where the whole systems were created by their relationships among subatomic particles. Bohm argued that in this process, the parts do not remain as parts, they are drawn together by a process of internal connectedness. It is not difficult to recognize ourselves as electrons in organizations, moving, merging with others, forming new wholes, being forever changed in the process (Bohm).

Quantum Change Forces

Canadian health care authorities are under pressure to innovate and change in order to reduce costs while reducing service times and improving health outcomes. Change management is a prime focus for all leaders in health care organizations. Wheatley (1999) stated that we think we were being helpful to others when we manage change so carefully because we believe that people do not like change. We have not thought that we might work with the forces of change and keep it under control every cautious step of the way (Wheatley). It is a particular characteristic of the human species to resist change, even though we were surrounded by tens of millions of other species that demonstrate wonderful capacities to grow, to adapt, and to change.

"New Science" is filled with tantalizing and hopeful processes that foster change (Wheatley, 1999). New science and quantum theory suggest that we must learn to look past an object or thing into the invisible level of dynamic processes. Wheatley suggested that we should lay aside the machine metaphor with its static mechanisms and separated parts. Yet health care organizations are expected to use machine-like business principles to analyze and improve their operations on a continual basis.

A system must develop greater self-knowledge in three critical areas (Wheatley, 1999). People need to be connected to the fundamental identity of their organization or community. Who were we? Who do we aspire to become? How should we be together? People need to be connected to new information. What else do we need to know? Where is this new information to be found? And people need to be able to reach past traditional boundaries and develop relationships with people anywhere in this system. Who else needs to be here to do this work with us? This is critical in a health care environment.

Conclusion

Newtonian science has been used to develop logically empirical, mechanistic, and scientifically-focused organizational and business management theories where one can attempt to reduce health care organizations to numbers, objective parts, and measurement and to construct them in a positivistic manner. Critical theory and postmodern organizational paradigms, which support a patient-centered health care model, do not agree with these views of organizations.

If business schools and management theories, including the ones utilized by Canadian health care authorities, base their purpose and teachings on the basis of scientific fact then they must now reshape these theories and practices based on the principles of "New Science". "New Science" uses uncertainty, complementarity, interconnectedness, relationships, wholeness, and implicate order to help address the qualitative, subjective, and humanistic nature of innovation and change needed in Canadian health care organizations.

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