PROJECT MANAGEMENT IN THE AGE OF COMPLEXITY AND CHANGE

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ABSTRACT

This paper presents a study of complex society and its relationship to project management. Complex society is characterized by open systems, chaos, self-organization, and interdependence. Accelerated change drives instability and chaos following an autocatalytic process. The conventional project management approach assumes a world of order and a predictable environment in which one can set and deliver a clear set of goals in a defined manner. The traditional approach is open to challenge. The author argues that a paradigm shift in project management is essential for it to be relevant and effective in a complex society of this century. Research is needed to further define a fresh understanding of project management and how it can respond to the challenges of a complex society. This necessitates working globally to advance the field.

Keywords: complexity theory; open systems; chaos; project management

Complex society is an evolutionary state of society that sociologists call the "take-off" stage. It exhibits the following characteristics:

- **Open systems.** A complex society is composed of a complex web of interacting open systems that are subject to instability, and are changing constantly within an Internet-like network of interconnections and interrelationships.
- **Chaos.** Complex society is affected by uncertainties that are beyond long-term contemplation and, thus, defy the classical management approach of orderly planning and control. Social systems change when the conditions are right following an autocatalytic process.
- **Self-organization.** In a complex society the tendency is for self-organization to take place following the autocatalytic process, leading to autonomous, organic (self-steering) organizational units, based on insights and competence of the actors, as well as synergy, flexibility and teamwork.
- **Interdependence.** The growth of interdependence makes it increasingly difficult, if not impossible, to make any predictions on the basis of previous experience. Thus, it is important to avoid development and use of a linear reductionist model for forecasting the behavior of future events.

These characteristics illustrate the rising complexity in the society that stem from rapid technological, social, economical and global change, considered by many as irreversible (Geyer, 1998; London, 1996). The science of complexity has shown that systemic change is not a mechanistic, progressive, and linear phenomenon whose causes and effects can be clearly isolated.

The science of complexity has now developed to the extent that it is applied to many fields, such as natural and social sciences, management, and the arts. For example, Tyson (1998) argues that it has changed the worldview of science in all spheres, including social sciences. There is a growing body of literature on this subject and a number of Internet portals serve the interests of the research community (e.g., http://www.brint.com/Systems.htm). CIO Magazine, as quoted in the preceding portal, states:

However, most traditional management literature has focused on control as a means of compliance instead of self-regulation and self-control and on extraneous rewards and incentives instead of intrinsic motivation. However, a
better understanding of autonomous human behavior underpinning individual, group and social interactions is required for appreciating the notions of self-adaptive and emergent systems. (CIO, April 15, 1998)

Knowledge-Based Society and Change
Knowledge-based society is the manifestation of the accelerated technological, social and economic change embodied within a complex society. While change has been in progress since the dawn of creation, it has seldom been felt so drastically as in current times (Geyer, 1998; London, 1996). In the past, the rate of change was rather slow, so in a person's lifetime change was virtually imperceptible. But now, in a lifetime, one experiences significant change influencing all aspects of life. According to Geyer (1998):

Change is not only here to stay, but the rate of change itself is increasing, also as a result of increasing global interdependence in all imaginable areas of human activity, and shows no signs of ever slowing down. This leads not only to change in existing procedures, institutions, ideologies, etc., but also to the emergence of completely new phenomena in the present information age. (p. 2)

Modern society has come a long way from that which existed 200 years ago at the dawn of the industrial revolution (Kelly, 1997). The rate of change will accelerate even further as the boundaries between national and global economies merge and as the free trading blocs evolve into integrated social and economic communities, such as that of the European Union (Jaafari, 2001). A look at the economies of advanced nations is most revealing in comparison with the smokestacks of the 19th century, as articulated by Sorrell (2001):

- People and organizations producing wealth from innovation and ideas, intellectual property, workforce competencies, research and development, rather than wealth production being primarily dependent on the control of physical or financial assets;
- Information and communications technology driving both economic and social growth (and productivity);
- The creation of web-like value chains in a global marketplace rather than linear, geographically narrow value chains. Increased opportunities for export and greater availability of imports;
- An increase in the trade of “intangible” goods and services (know-how, design, branding, etc.) and increased provision of customised as opposed to commodity goods/services;
- A regulatory environment which encourages people and organizations to be entrepreneurial, to innovate and to take up technological advances;
- Capital markets which value innovation and know-how and actively stimulate growth in this area of the economy.

Change has thus transformed, and continues to transform, the world in which we live. How can we understand and model change? Without a proper perspective on change as a phenomenon, we cannot understand what possible role project management can play in the complex societies of the 21st Century, and how the less advanced societies can be assisted in their quest to achieve accelerated economic and social progress.

Herbert Spencer, Karl Marx, and August Comte have all subscribed to an evolutionary view of change (London, 1996). These authors' conviction of the irreversibility of change was typical of the late 19th Century's widely held scientific belief that progress was natural. Commenting on the contemporary view of that time, London (1996) states:

The dynamic force in progress was, like that in biological evolution, the competitive struggle for existence in which the fit survive and the unfit perish. This interpretation of social change was especially popular among the so-called Social Darwinists (even though Darwin himself was no Social Darwinist and Spencer's theory of social evolution preceded Darwin's theories of biological evolution by several years.) (p. 3)

A study of change as a phenomenon will bring with it the question of who directs the change and what sort of reaction it generates among those who experience change. The theory of complexity has shown that change takes place spontaneously and as a result of what is referred to as an "autocatalytic" process.

The concept of autocatalytic process generating change is rather new and relates to Prigogine and Stengers (1984) and later Kauffman (1991, 1992 and 1995) and a number of other researchers working at the Santa Fe Institute. The advent of the new science of complexity has been largely attributed to Prigogine, a 1977 Nobel Laureate in Chemistry, whose landmark book Order out of Chaos explored the nature of change through "dissipative structures" or open systems.

Researchers since have found that there are surprising similarities between natural and social systems when it comes to the study of change. The science of complexity postulates that the advent of life and evolution of biological complexity, from simple organisms to what can be observed today, were not the product of chance, but part of a natural evolutionary order following the autocatalytic process. Geyer (1998) states:

Under an autocatalytic process simple chemical laws coupled with the presence of a sufficient number of frequently interacting elements produce ever more complex elements, with new characteristics, that often turn out to be part of new catalytic processes at higher levels of molecular complexity—processes which in turn boost the emergence of still higher levels of complexity. (p. 3)

The economist Arthur (1990), collaborating closely with Kaufmann at the Santa Fe Institute, applied the concept of autocatalytic sets to the economy:

The economy too bootstrap its own evolution, as it grows more complex over time. Beyond a certain critical threshold, phase transitions occur;
stagnant developing countries can enter the take-off stage when their economy has diversified sufficiently. Increased trade between two countries in a subcritical state can similarly produce a more complex and interwoven economy which becomes supercritical and explodes outward. Catalytic effects might also operate in phase transitions that are considered negative, where critical thresholds of violence are passed as in Northern Ireland or Bosnia. (p. 94)

Thus, according to the autocatalytic view, economic and social orders both cause and experience change, and what we observe and measure in a particular time is a snapshot of what otherwise is a continuum of evolution. Change is always at work, chiseling at the base of stability of a system and preparing the system for a sudden and rapid shock, called a phase transition.

Examples of phase transitions can be observed in nature, e.g., when ice reaches the melting temperature it turns into water, which in turn converts into steam when it reaches the boiling point. While we only see the sudden change of water turning into steam, the reality is that water molecules would have been heated continuously, thus paving the way for a phase transition at a critical point. This analogy applies to social systems, driven by technological, political and social catalysts.

**Perception of Complex Society**
The contemporary view in sociology is that there is an outside reality (i.e., as opposed to what is residing inside people's minds), but not necessarily an objective reality, and that individuals, depending on their mental models, normally perceive this reality in their own way. (Geyer, 1998) Mental models are observer-dependent, time-dependent and problem-dependent. In addition to these dependencies and to grasp the complexity of the environment, a certain amount of internalization of the outside reality or complexity reduction of the environment is needed. This is a function of the competency of the individual concerned. Luhmann (1978 and 1986) calls this a "complexity differential" between the individual and the environment. If this reduction is not optimal, then the observer views the world as either too complex or too simple, both of which may lead to sub-optimal reactions.

**Responses to Societal Complexity**
How does an accelerated change (and rising social complexity) influence the society as a whole or the individual and groups within it? Research has shown that increased social complexity has resulted in increased self-reference at the individual level and a rise in self-organization at the group level. (Geyer, 1998; Kirshbaum, 1999)

**Individual Self-Reference**
Self-consciousness or self-reference is a natural human trait that can be enhanced through linguistic abilities for codification of information, internalization and processing of the same and subsequent communication and reflection. Self-reference is on the rise and as a reaction of individuals to the rising environmental complexity. Self-reference assists an individual in developing capabilities to understand and digest environmental complexity, and in applying an appropriate degree of environmental complexity reduction internally, in order to better handle external complexity and uncertainty in decision-making. Geyer (1998) states that self-reference is on the rise in tandem with rising environmental complexity.

Normally, those who have developed a high degree of self-reference are those who thrive on change and have developed adequate capacity to handle environmental complexity. These are the people who will not only be at the forefront of change, but will be its driving force, adapting quickly to new circumstances they have themselves helped to create. Usually, they come from the rich countries, have had a nurturing early-life environment, and have a high degree of education. Self-reference can be further developed through reflective learning and evaluation of the behavior (or feedback) from the immediate environment to one's internal model, the latter being updated regularly in response to a rapidly changing environment.

Development of reflective practice is a long process and requires a high level of education and professional development, not normally attainable through short-term training.

**Group Self-Organization**
At the group level, autonomous organizations tend to grow, both as a natural response to the environmental complexity and due to individual complexity reduction capabilities. Self-organization runs opposite to hierarchies. Geyer (1998) states:

However, like the iterative sequence of variety-selection-stabilization has become a more or less accepted paradigm in evolutionary studies, societal evolution likewise seems based on, first, proliferation of variety (i.e., self-organization), then selection of those self-organized units that can stand the test of time, and finally emergence of a new hierarchical level to coordinate these self-organized units.

Sociology has always been rather ambivalent about hierarchy, and an important issue in social science has always been whether one should opt for the "katascope" or the "anascopic" view of society; in other words, should the behavior of individuals and groups be planned from the top down, in order for a society to survive in the long run, or should the insight of actors at every level, including the bottom one, be increased and thereby with their competence to handle their environment more effectively and engage more successfully in goal-seeking behaviors? (p. 9)

Chin and Benne in their classic textbook *The Planning of Change* have offered three approaches to triggering change or, as they call them, general strategies for effecting changes in human systems: rational-empirical, normative-educative and power-coercive.

The rational-empirical approach states that, provided the appropriate conditions are in place, people will behave rationally and will embrace change. Chin and Benne offer the following strategies to effect change under a rational-empirical approach:
• Provide the right information, education or training to allow individuals to change of their own volition.
• Ensure that the "right" people are in the right "place" to bring about needed changes.
• Invite the perspectives of outsiders.
• Engage in research and development.
• Promote utopian thinking to stimulate creativity and "best-case" scenarios.
• Clarify the issues and/or reconceptualize the situation in order to bring about greater overall understanding among members of the group.

The normative-reeducative approach is founded on the assumption that change begins from the bottom up, not top down. Under this approach it is appropriate to focus on changing the individuals who make up a social system. Chin and Benne offer the following strategies for applying this approach:

• Improve the problem-solving capacities of a system by encouraging individuals to be self-diagnosing.
• Release and foster growth in the persons who make up the system.

The third approach, power-coercive is for effecting change through political movements and social activism. Strategies offered by Chin and Benne are:

• Using political institutions to achieve change.
• Shifting the balance of power between social groups, especially ruling elites.
• Weakening or dividing the opposition through moral coercion or strategies of non-violence.

The recent trend is for self-organization to proliferate in tandem with the increased environmental complexity. Witness the rise of SMEs and their economic influence in advanced economies of the world. As a matter of fact, the growth of self-organizing units within clusters of such units in advanced economies is taken as indicators for economic strength in this century. Kotkin and Devol in their book The Renewed City in the Digital Age (2000) state:

Under the new regime of geography, wherever intelligence clusters—small towns, big city or any geographic location—that is where wealth will accumulate. Such concentrations are far less constrained by traditional determinants such as strategic location near waterways or raw materials, or by the proximity to dense concentrations of population. (quoted in http://www.livable.com/Programs_pages/CCResourcePaper.htm)

However, self-organization is not confined to new and technology-based enterprises. It is a post-war phenomenon and appears to be the basis for advanced societies functioning more efficiently and effectively. The role of governments has changed to that of facilitator, not driver of economic and even social progress.

Self-organization in management manifests itself mostly in the form of "learning organizations" in the sense that these are self-designing, self-assessing, self-renewing and entrepreneurial organizations. (Senge, 1990; Kanter et al., 1992) Learning organizations are flexible and open. Systemic change occurs simultaneously and synergistically, based on the competence and perceptions of individuals, teams and larger groups and in response to environmental change. Has there been a huge rush to embrace the concept of learning organizations in management? The reality is that learning organizations are little understood or applied in a meaningful way. Most organizations are reluctant to embrace change unless these are externally driven. (Kanter et al., 1992)

A learning organization is one in which five learning disciplines are continually pursued: personal mastery, improving individual mental models, building a shared vision, team learning, and thinking systematically. According to Senge (1990), the fifth discipline—systems thinking—ties all these disciplines together. Senge (1990) notes that the really significant and enduring innovations he has observed have grown out of people from multiple constituencies working together. In education, for instance, London (1996) noted:

It’s been a few committed teachers with some bright ideas, in concert with a principal who has a particular view of his or her job, in concert with a superintendent who is in line with that principal, and in concert with people in the community who are very much part of the innovation process. (London, 1996)

Self-organizations can function in response to complex rules and principles, ranging from the constitutions of nations through to fiscal and economic policies and regulations of regions, or social and civic codes of communities and self-imposed moral standards or ethics. It appears that these self-organizing groups of people form the building blocks of a knowledge-based society.

Individual Behavior and Response to Change

According to Geyer (1998), people can be classified into four basic types in terms of their responses to change: those who thrive on change; those who try to abstain from change as far as possible; those who resist change; and those who experience change unknowingly and somehow cope with it or are oblivious to it (p. 5). Obviously it is possible for a person to experience or exhibit more than one type of response during his or her life. Also, humans can exhibit more than one reaction to complex situations, depending on their mental models, information and media manipulation, social norms and accepted standards, peer group pressure or group think phenomenon. Nevertheless, the classification offered by Geyer is very useful in the sense that it provides an insight into, and an explanation of the underlying causes for the social, political and economical tensions that currently beset the world.

Table 1, developed by the author, contains a detailed point comparison of the four types of people in terms of their behavior and reaction to change. As seen, the ideal advanced knowledge-based society is the one whose members are partial to change and possess considerable social and economic skills. That is a society based on well-educated, self-organizing, competent citizenry, not on tribalism or religious affiliation or ethnicity. This is
hard to achieve when, even in the case of advanced societies, the majority of the population tend to be uncomfortable with change, withdrawing from the complex society as far as they can.

Hofstede in his book *Culture and Organizations: Software of the Mind* (1991) states that basic human mental programming determines our approaches to personal relationships, business transactions and management. He developed the Lily Pond model (Figure 1), to provide a visual representation of the interrelationships. Values are based on the ingrained assumptions about what is right or wrong. He found that the underlying human assumptions are based on family, education, linguistic, gender, social, regional, religious and ethnic backgrounds (cultural and family influences). Values influence the attitudes and perceptions, which in turn influence our behavior.

Of course, what is seen is the surface of the pond or our exhibited behavior; what should be taken into account in any cultural transformation studies is the entire value system. Thus, early socialization plays a key role in personal formation and development. The agents of socialization include family, school, peer groups, media, and religious and political institutions. These agents make individuals aware of what is acceptable behavior and what constitutes the norms, values and prevailing culture of their society. According to Geyer (1998):

*One has minimally to take into account one’s “programming” through early-life socialization, the myriad subjective filters, prejudices, experiences, etc. which one has accumulated in the course of a lifetime, and has to reckon also with the limited factual knowledge and computing capacity of the human brain which can hold only so many variables simultaneously. (p. 5)*

Considering the complex society, the relentless pace of change, the unequal division of affluence, wealth and opportunity around the globe, what should be the role of project management at both individual and organizational levels?

Take the example of stakeholders' management. An essential project management competency must surely concern the assessment and effective management of the different types of reaction that change can generate, in the context of a project or a business unit operation. The literature on stakeholders' management (c.f. Manivong, 2000) holds that managing stakeholders is no more than devising a process of engaging, and effective communication with the stakeholders. This process management perspective implicitly assumes that all stakeholders are Type 1 persons and embrace change easily.

The majority of people, even in advanced societies of the West, are not interested in active involvement in the lives of their communities. They seek gratification from involvement in niche areas of their interest, e.g., sports, arts or things that they can relate to and/or receive immediate feedback from their engagement. These are Type 2 people who feel it is pointless to involve themselves with the large-scale issues over which they cannot have any influence. Sometimes they are referred to cynically as the silent majority. While they pose no immediate danger to societal stability, their apathy can be a threat to the long-term evolution of the society (Geyer, 1998).

Project Management in the Age of Accelerated Change

In many countries of the world where the dominant view is that of strong religious or cultural affiliation, there will be a predominance of Type 3 persons, who not only resist change, but may, in fact, mount a concerted battle against it. Thus, there may be inherent resistance to any project that threatens the traditional values of the affected communities or the power base of their leaders. How should project managers approach change in this type of setting?

Type 4 persons are also of contemporary concern, as they are normally the forgotten people of the third world whose focus is on survival, finding enough to eat or shelter for themselves and their families. They are neither aware of nor in a position to influence their society. How should project managers approach projects in these and any other disenfranchised sections of the world communities?

The example of stakeholders' management highlights the complexity of project management in a complex society and management of change. Contrary to the common belief that project management is the tool to change management, there is no evidence to suggest that the current models of project management are capable
<table>
<thead>
<tr>
<th>Point</th>
<th>Type 1 (Nerds)</th>
<th>Type 2 (Average citizens)</th>
<th>Type 3 (Fanatics, extremists)</th>
<th>Type 4 (Outcasts, downtrodden)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character</td>
<td>Reflective, aware and attuned to the surrounding environment, in search of new information and experiences, outcome focused, goal driven behavior</td>
<td>Introvert, withdraws from complexity, limits confrontation with change, seeks simplistic pursuits, likes quick response from own actions, feels cannot influence complex situations</td>
<td>Reactive, resists change, follows group thinking, threatened by complexity, in search of pure ideologies, character defined by absolute beliefs, as in religion, driven by hate</td>
<td>Uninvolved, disinterested, not concerned with change or passively accepts it, submissive, downtrodden, feels uncounted or accepts exploitation and abuse of all sorts</td>
</tr>
<tr>
<td>Capability</td>
<td>Leading change, competent in the application of professional tools and techniques, competent to practice in a field of endeavor, possesses social cultural competencies</td>
<td>Competent in narrow areas, e.g., simple intellectual tasks or trades. Able to read and write but not to understand the complex societal issues over which they feel have no control</td>
<td>May have expertise in a field but generally not worried about keeping up to date, guided by fundamentalism in all spheres of activity, generally engages in anti-establishment activities</td>
<td>Not generally articulate, no definitive skills, mostly engaged in subsistence living, concerned with immediate survival issues of food and shelter</td>
</tr>
<tr>
<td>Approach</td>
<td>Open minded, follows an open systems thinking, mental models are time, problem and observer dependent</td>
<td>Superficial, finds it easier to follow dominant lines, open to manipulation, follows simple and ingrained mental models</td>
<td>Follows oversimplistic philosophies, fanatical as of religious extremists, white supremacists, or other similar fringe groups</td>
<td>Mostly fatalistic, accepting wretchedness as natural, feeling powerless, follows survival instincts</td>
</tr>
<tr>
<td>Criteria</td>
<td>Fitness of purpose, fitness for purpose, value, harmony in relationships, personal ethics, resolution of conflicts, faith</td>
<td>Emotional and socio-ethnic bias, closed value system, seeks immediate feedback, ok to live with high ambiguity, wary of change</td>
<td>Blind belief in own ideologies, absolute and resolute in one's righteousness, guided by group reaction and engage in endorsed activities</td>
<td>Survival and keeping alive, not overly concerned with criteria as feels powerless to change own destiny or the environment</td>
</tr>
<tr>
<td>Self-reference</td>
<td>Changing and renewing own mental models, aware of, and self-referential</td>
<td>A low degree of self-reference as relates to interaction with a small circle of friends and workmates, in pursuit of hobbies</td>
<td>Non-existent as one is guided by others' expectation, standards, &quot;established wisdom&quot; and an absolute truth</td>
<td>Practically non-existent, guided by social order and class systems (as in India), knows own place in the society</td>
</tr>
<tr>
<td>Development</td>
<td>Normally from a rich country, well educated and enculturated, well nurtured family, professional development, independent thinker and learner</td>
<td>Forms possibly the majority in Western democracies, well schooled but not empowered, may even be a professional society member, highly dependent thinker and learner</td>
<td>Normally from developing countries with low education and formation, strong religious and ethnic enculturation, or extreme groups in developed countries with low education and no proper formation</td>
<td>Normally from third world countries without even basic education, health or other developmental benefits taken for granted in developed countries</td>
</tr>
</tbody>
</table>

Table 1. Characteristics of Four Types of People in Terms of Reaction to Change

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of assisting change management or aiding planning, creation and delivery of complex value chains globally. One thing is clear: a classical approach to management of projects, as taught in project management courses or espoused in literature, may have a limited utility on the face of accelerated change and increased complexity.

The prevalence of failure currently experienced on many technology-based projects has been studied widely and found to be generally related to managerial approaches to human and organizational factors, rather than technology per se. Many IT/IS projects are highly complex projects that seek to transform organizations in a profound way. The author submits that this is a manifestation of the failure of the contemporary project management model to respond to the challenges faced by this class of projects.

management) to define four typical approaches or models as shown in Figure 2: (1) ad hoc model; (2) bureaucratic model; (3) normative model; and (4) creative-reflective model. This approach enables us to identify whether or not the contemporary models of project management are capable of responding to the complex society, and also whether or not approaches to professional development of project managers reflect the dynamics of the complex society. Essentially, this classification reflects the evolution of project management over time and in response to rising environmental and project complexity.

**Type 1: Ad Hoc Model**

This approach was typical when project management was not recognized as a systemic approach and when organizations used to apply ad hoc methods to achieve their desired outcomes. At a time when both environmental complexity and project complexity were low, projects could be defined as departmental initiatives and handled informally by any person who happened to be closest to the action without any due concern about the person’s competence or management of environmental complexity. Most professionals who landed this role were (and some still are) accidental project managers. They tended to use their experience and intuition to steer the project to a conclusion.

The Type 1 model is prone to conflicts. On the face of observed unacceptable deviations in project functionality, cost or duration, the search for the guilty party will begin and normally end up in messy and protracted litigations. The premise in this methodology is that all facts are known and project deviations are the result of default on the part of the participants in the process.

This model of project management is typically characterized by an absence of any formal systems and/or consideration of the competence of the individual players. Most decisions and the rules are made on the run, and decision makers’ positions can vary considerably depending on their “gut feelings” of the situation.

Type 1 approaches work when the environmental complexity is rather low and when a project is also simple enough that the players can get their minds around it and/or the project is really of a similar line. Figure 3 shows its limitations.

**Type 2: Bureaucratic Model**

This approach is common on many public sector projects and undertakings. It is the next step in the evolution path and a reaction to the often spectacular project failures under the previous models when significant complexities are present. Many organizations have typically sought to influence the project outcomes by imposing bureaucratic controls, involving overelaborate procedures,administrative processes, approvals and maintenance of records. Typically, the project is run for full bureaucratic compliance rather than for achieving optimal results. Such approaches tend to be either overcomplicated and/or oversimplified, both of which are due to the managers’ inability to apply an appropriate degree of environmental complexity reduction, and/or due to a set of rigid organizational policies and methodologies.

The author speculates that project managers of this approach are typically those who resist change and despise environmental complexity interfering.
<table>
<thead>
<tr>
<th>POINT</th>
<th>MODEL A</th>
<th>MODEL B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character</td>
<td>Technical, logical; problem-solving</td>
<td>Creative, interpretive; design</td>
</tr>
<tr>
<td>Capability</td>
<td>Solvable, convergent problems</td>
<td>Congruent futures; “messes,” problematic situations, divergent problems</td>
</tr>
<tr>
<td>Approach</td>
<td>Solving problems; applying knowledge competently and rationally</td>
<td>Understanding problematic situations and resolving conflicts of value; framing and creating desired outcomes</td>
</tr>
<tr>
<td>Criteria</td>
<td>Logic, efficiency, planned outcomes; cause-effect, proof</td>
<td>Values, ethics, congruence of both methods and outcomes; systemic interrelationships, theory, faith</td>
</tr>
<tr>
<td>Epistemology</td>
<td>Objectivism: knowledge is stable and general; precedes and guides action</td>
<td>Constructivism: knowledge is transient, situational, personal and unique; both informs action and is generated by it</td>
</tr>
<tr>
<td>Validation</td>
<td>By reference to others’ expectations: standards, accepted wisdom, established</td>
<td>By questioning fitness for purpose, fitness of purpose and systemic discourse; truth, validity and value</td>
</tr>
<tr>
<td>Thinking</td>
<td>Primarily deductive / analytical; skeptical of intuition</td>
<td>Inductive, deductive and abductive; uses “intelligent intuition”</td>
</tr>
<tr>
<td>Profession</td>
<td>A bounded, externally-defined role, characterized by norms, values and a knowledge-base common to the profession</td>
<td>A portfolio of educational activity individual to the practitioner, integrated by personal identity, perspectives, values and capabilities</td>
</tr>
<tr>
<td>Professionalism</td>
<td>Objectivity, rules, codes of practice</td>
<td>Exploration of own and others’ values, personal ethics, mutual enquiry, shared expectations</td>
</tr>
<tr>
<td>Professional standards</td>
<td>Defined by the employer, professional body or other external agency according to its norms</td>
<td>Negotiated by the participants and situation in accordance with their values and other stakeholders in the practice values, beliefs and desired outcomes</td>
</tr>
<tr>
<td>Professional</td>
<td>Initial development concerned with acquiring development knowledge, developing competence and enculturation into the profession’s value system; continuing development concerned with maintaining competence and updating knowledge</td>
<td>Ongoing learning and practice through reflective practice, critical enquiry and creative synthesis and action; continual questioning and refinement of personal knowledge, understanding, practice, values and beliefs</td>
</tr>
</tbody>
</table>

Table 2. Point Comparison between Two Principle Models of Professionality (Lester 1994)
with their routine decision-making and operational freedom. They are in search of stability and an imposition of order (command and control) mode of management. They feel that their power base can be threatened by the introduction of change and/or deviation from “established procedures.” This model has more to do with maintenance of power and imposition of control than with good management practices. Most practitioners of this model work with the same model, irrespective of the nature of their projects.

As with the Type 1 model, the capacity of this approach to handle both environmental and project complexity is really limited; at best, it can work when both environmental complexity and project complexity are in the range of low to medium (Figure 3).

**Type 3: Normative Model**

This type is the contemporary model of project management (the so-called best practice model) which, according to Lester (1994), falls within Type A of professions that are technical/bureaucratic in nature and knowledge-based (“the Industrial Revolution model, embracing both the professionalization of the medieval trade guilds and the 20th century managerial professions”). Based on the work of Schön (1983) and Fish (1995), Lester (1994) has defined the normative model as Model A professionalism (see Table 2 for details).

This model works best when the environmental complexity (or extent of uncertainty) is low, and when project managers are able to apply an optimal degree of environmental complexity reduction. Type 3 is the rational approach, and assumes that there is sufficient certainty and stability in the environment that it will be possible to define a set of goals and a framework for orderly planning and delivery of projects. Nearly all published bodies of knowledge, approaches by professional bodies, and their certification schemes underline this model.

The Type 3 model has a limited capacity in handling environmental complexity, though it can handle a high degree of project complexity (Figure 3). Its limitation has already been reflected in reported project failures in complex IT and software systems, new complex products and organizational transformation (to name a few).

**Type 4: Creative-Reflective Model**

Type 4 is well suited to projects that are typically conceived and delivered within a complex society. It relies on the ability of professionals to apply an optimal degree of environmental complexity reduction to handle a high degree of uncertainty and even thrive on the edge of chaos. This model relies on the principles of self-organization, and the insights and competence of the players in the project value chain. Practitioners in this model are empowered individuals, who possess a high degree of self-referential skills and are partial to change. Their functions transcend that of a rational process-driven approach to that of a creative approach through which they are able to achieve breakthrough solutions to optimally respond to both environmental and project complexity.

Project managers are necessarily Type 1 people when it comes to handling complexity and change. Geyer (1998) characterizes them as follows:

1. They will be fully aware that their models are observer-dependent, i.e., they are open to new information from those with different models, and will engage in a sufficient amount of self-reference to be at least roughly aware how their own models have originated, depending on their early-life conditioning, subsequent socialization and resulting psychological make-up;
2. They will be sufficiently flexible to realize that their models are not eternally valid, but time-dependent, and therefore should be updated regularly as new information becomes available, or is even actively sought;
3. Realizing that their models are also problem-dependent, they will certainly not strive to obtain a single, monolithic model of their world, but will develop a set of different models to deal with different situations. (p. 5)

Lester (1994) refers to this class of professionals as Model B. He has provided an interesting point comparison
between the normative (Model A) and creative-reflective (Model B) included in Table 2.

Creative-reflective project managers are not necessarily members of a particular professional body, but those who engage in lifelong learning and continuous personal development, act autonomously, believe in shared values and follow strong personal ethics.

**Preparation of Individual Project Managers**

The emergence of the complex society as a manifestation of rapid and irreversible change signifies that models for project management preparation cannot be based on past practices, as the bandwidth within which an appropriate degree of environmental complexity reduction can be applied is moving in parallel to the rise in environmental complication. As was put by Jarvis (1983), “Using a list of empirically-derived criteria without an underlying theory can be arbitrary (and provides rules based on past practices rather than principles applicable to future ones).”

Robinson (2000) argues that a new style of leadership—dubbed transformational leadership—is emerging in order “to allow individuals and organizations to thrive at the edge of chaos, inspiring the innovation and creativity needed to develop new products and technologies, even new business models that can lead to sustainable competitive advantage in the new economy. The context for transformational leadership includes a kind of visionary acumen that can articulate winning and success in a way that captures the imagination of others. In doing so, like-minded contributors can be invited to add their views to amplify the meaning and purpose of the company such that everyone is inspired to do their best work and serve the greater needs of the enterprise and its customers”.

The author postulates that the transformational leadership is reflected in the creative-reflective approach to management of projects, and that development of project managers needs to change from the current pre-occupation with learning techniques for the application of the so-called best practice to competency for management of both project and environmental complexity. The professional competence of project managers must, therefore, be the basis for determination of an optimal approach to projects, based on the extent of environmental and project complexity, and within a flexible framework. As seen, in addition to the core emphasis on creative-reflective skills, leadership and socio-cultural competencies become critical, compared to planning and control competencies emphasized in the normative project management literature and practice (Lester, 1994; Robinson, 2000).

Empirical research is needed to shed light on the proportion of project managers in each category, in terms of reaction to change and also subscribed-to project management models. The author's experience in the development of project managers through the graduate program at The University of Sydney, as well as various research work, suggests that the current models for professional preparation and certification tied to the normative approach are ill-suited to the emerging complex society.

**The Need For International Collaboration In Research**

The emergence of the sciences of complexity as studied in this paper brings with it the question of project management relevance in the age of open systems, chaos, self-organization and interdependence. The author put forward a progressive perspective of project management evolution and argued that the creative-reflective model is best suited to handling complexity and chaos. However, this model is not known as the contemporary view of project management, that of a rational and normative approach driven by techniques.

As noted, the normative approach cannot handle environmental complexity well. There is an acute need to develop the creative-reflective model, including the relevant bodies of knowledge that enable management of projects in the age of complexity. The same sort of concerted multi-disciplinary efforts that led to the creation of the sciences of complexity at Santa Fe Institute in the latter part of the 20th Century need to take place in project management to develop the creative-reflective model of project management. This is the reason for the author advocating international collaboration and coalition of institutions to advance the project management body of knowledge and mindsets to their next level of development.

**Conclusions**

The author attempted to present a study of change and its relationship to rapid growth of complex society following the autocatalytic process, as part of the new sciences of complexity. Research has confirmed that, generally speaking, the world is subject to an accelerating rate of change and that the emergence of the complex society is a stage in the process of continual evolution. This stage has been referred to as a take-off state, exhibiting instability and chaos and characterized by open systems, self-organization and interdependence. Individuals react differently to change depending on their internal model and the context and time. In addition, rapid rise complexity has given rise to an increase in self-reference and self-organization. Not everyone perceives the complexity in the same manner, even when the context remains the same. Each person needs to apply an appropriate degree of complexity reduction to understand and internalize an image of environmental complexity.

Project management is supposedly a systemic approach to management of change, but its foundation lies in the traditional rational managerialism, thus facing an increasing threat of irrelevance unless newer models are developed to respond to change and complexity. The author has put forward a concept for a creative-reflective model that is effective in the age of complexity. The elements of this model as yet remain to be researched and developed.
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