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# Systems thinking for project management: implications for practice and education

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## Abstract

Deriving from a critique of the theory of management that has influenced the practice of project management, this article explores an alternative paradigm in the form of systems thinking. The known multi-disciplinary usefulness of systems thinking is proposed as a means of reconsidering project planning, implementation and control, leading to potential implications for the education of project managers.

The appropriate selection of systems approaches for use in the planning and control of complex projects in any development sector, including construction, is considered. Although the specific details of any specific 'process-based' systems approaches are not presented, the conceptual rationale for such approaches to project planning and control is presented.

This is done within a framework of critical consideration of those factors that are argued to contribute to failure to meet key project outcomes, especially in complex projects. Contemporary literature (extensively referred to in this article) increasingly suggests that there are limits to the established 'rational-oriented' approaches to project management. The current body of practice knowledge requires the addition of complementary, 'process-based' approaches for a new generation of strategic project managers. Specific recommendations for educational development in this regard are made.

This article explores the influence of contemporary organisational theory on project management and hence the need to add critically necessary soft skills capacity to the current body of knowledge.


Keywords: Project management, systems thinking, complexity theory, project management education


## Abstrak

Hierdie artikel ondersoek 'n alternatiewe modelwoord in die vorm van sisteemdenke wat afgelei is van 'n kritiek oor die teorie van bestuurswese wat 'n invloed op projekbestuur gehad het. Die bekende multidissiplinêre bruikbaarheid van sisteemdenke is voorgestel as 'n manier om projekbeplanning, implementering en beheer te heroorweeg, wat kan lei tot potensiële implikasies vir die opleiding van projekbestuurders.

Die toepaslike seleksie van stelselsbenaderings vir gebruik in die beplanning en beheer van komplekse projekte in enige sektor van ontwikkeling, insluitende konstruksie, word oorweeg. Alhoewel dit nie die aanbieding van die spesifike


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besonderhede van enige spesifieke 'proses-gebaseerde' stelsels voorstel nie, word die konseptuele rasionaal vir sulke benaderings aan die projekbeplanning en beheer voorgestel.

Dit word gedoen binne 'n raamwerk van kritiese oorweging van die faktore wat aangevoer word om by te dra tot versuim om te voldoen aan die belangrikste projek-uitkomste, veral in die komplekse projekte. Kontemporêre literatuur (volledig uitgebrei en na verwys in hierdie artikel) dui toenemend daarop dat daar grense is aan die gevestigde 'rasionele-georiënteerde' benaderings tot die projekbestuur. Die huidige liggaam van die praktykkennis vereis die byvoeging van addisionele 'proses-gebaseerde' benaderings vir 'n nuwe generasie van strategiese projekbestuurders. Spesifieke aanbevelings vir die opvoedkundige ontwikkeling word in hierdie verband gemaak.

Hierdie artikel ondersoek die invloed van eietydse organisatoriese teorie op projekbestuur en vandaar die nodigheid om krities nodige sagte vaardighede-kapasiteit tot die huidige liggaam van kennis toe te voeg.

Sleutelwoorde: Projekbestuur, sisteemdenke, komplekse teorie, projekbestuur-opleiding

## 1. Introduction

Projects typically represent a form of targeted organisational activity intended to bring about changes that may be mostly technical (as is usually the case in engineering projects) or process-redefining (as is usually the case in business transformation projects). The impacts of projects are seldom only 'technical' or only 'transforming' but typically a combination of both. It is believed that this combination (or balance) and the consequent approaches to project planning and control hold the key to improved project performance (Stoneham & Ainsworth, 2003: 1; Morris, 2004; Holmquist, 2007).

The development of the matrix organisational form as a device for multidisciplinary action for organisational change provided the early institutional framework for the emergence of project management. Projects therefore do emulate some of the attributes of organisations in terms of planning, implementation and systems of control. Many of these attributes reflect the industrial era or rationalist approaches to management which some writers consider to be a key problem for organisational management in general (Ackoff, 1999; Jackson, 2000) and for project management in particular (Jaafari, 2003; Kurtz & Snowden, 2003; Morris, 2004)

Projects also possess certain specific attributes that set them apart from organisations. These specific attributes are well-known, and are included in most definitions of projects. For the most part, definitions of projects would explicitly include words such as 'unique' and 'temporary' hence adding further dimensions of challenge that place projects in an area which, for most managers, would provide

challenge beyond that which is normal in the already confusing organisational world. Definitions of projects would also implicitly include the idea of change, meaning the intention to bring about improvement in some or other situation. It is hard to imagine that it would be otherwise. Change that catalyses decline or degradation would not be what any right-minded project manager would have in mind!

Yet many projects, on completion, are not shining examples of initial intent. Neither planning, nor implementation, nor systems of control seem to work, as is evidenced by late completions and budget overspends. Viewed in hindsight, which is where clarity of understanding is always best, many projects in both their execution and impact simply do not meet the expectations that accompanied their inception. Indeed, there are some shameful examples of projects where short-term success has soon been overtaken by long-term embarrassment. It appears that learning does not occur and that mistakes whose symptoms are so clear continue to be repeated, and have come to pervade the literature on project management. Attempts to enable improvement in project performance typically target the refinement of existing tools and techniques. A growing body of academic and practitioner opinion does not share the view that the road to improvement rests in refining what already exists. These opinions prefer to question the conceptual foundations on which project management has been built, thus suggesting a paradigm shift at a fundamental level. Morris (2000), Koskela & Howell (2002a), Sterman (2006) and Leybourne (2007), among others, critically reflect on the state of project management, mostly to emphasise its lack of the relevant and comprehensive theoretical capacity that could enable improved project management practices, especially in the post-industrial era. Singh, H. & Singh, A. (2002: 24) consider that all projects have some semblance of complexity, even chaos, associated with them:

> *In many respects, projects are like wars and military battles – there is wild confusion, disorder, discontinuity in information flow, and application of mistaken strategy - events that make projects spin out of control into complexity.*

It is indeed time to review the theoretical foundations that inform project management practices, and specifically to consider the usefulness of process-based approaches to the planning and control of projects. These approaches are embodied in a broader engagement of systems thinking in the management of projects. The essential purpose of this article is not to deny the considerable contribution of systems approaches already in use, such as Systems

Engineering, but to recognise the latent potential that other systems approaches offer for improved project management practice in the context of complexity.

To facilitate this purpose and to provide a framework for critical reflection, it is necessary to acknowledge that projects and their management cannot be completely abstracted from the organisational world and the bodies of theory that frame that world. Reflections on change and proposals for change are therefore preferably done from a position that first considers significant contemporary organisational challenges and debates. These challenges are many and diverse and cannot be fully explored in this instance. It is not the intention of this article to provide detailed examples of the use of alternative systems models or techniques. This article aims to suggest that there are well-developed, more appropriate, and contextually relevant planning and control frameworks in existence which can offer alternative planning decision support and control frameworks for more effective practice. Therefore, although project management has developed a language and set of practices that set it apart from general management, it is also true that a great deal of the language and practices of project management are derived from the world of general management. The developments in those areas are therefore relevant in setting a trajectory for debate and development in the field of project management itself. It is to that more general context that discussion is directed in the first instance.

The concerns are therefore first, a synoptic overview of the essential characteristics (and critique of) the dominant scientific paradigm (or rational-positivism) that influences a great deal of current business management, including the practice of project management; secondly, to understand the nature of the contemporary context for organisational and project management; thirdly, to consider the realised and latent potential of systems thinking as a 'process-based' approach to project planning and control and, fourthly, to offer suggestions regarding what could be part of the education of strategically minded project managers.

## 2. Synoptic overview of the characteristics and assumptions of scientific management

It has always been known that the universe is both complex and mysterious. Throughout history, people have sought to unravel the complexity in order to understand the mystery. This has been done mostly by means of the familiar Newtonian process whereby complex

problems are reduced into constituent parts (commonly known as 'reductionism'). Such a pursuit of better understanding has kept the scientific community active and has enabled great advances in knowledge and application, particularly in the furtherance of human technological competence. The familiar systematic analytical processes of science have indeed delivered much that is positive and empowering. The same analytical processes have, perhaps ironically, also led to a growing understanding of how limited those processes can be in relation to problems that analysis alone cannot resolve.

There can be little doubt that Newtonian science, as translated into the business context by F.W. Taylor, Gantt (and others) of the scientific management school has left a heavy imprint on the organisational world. Scientific management has formed the philosophical foundation for how business has organised itself, and how it has attempted to achieve its purposes. This is most starkly evident in bureaucracies where divisional separation, strictly defined hierarchies, assumptions about the linear nature of causes relative to effects, belief in the integrity of planning systems and a passion for control (or capacity to exercise control) would be some central distinguishing characteristics. The major production successes of the industrial age were an outcome of this prescriptive 'command and control' approach to organisational management. The management systems that evolved from scientific roots were well suited to the needs of the industrial era. In brief, scientific management as a conceptual basis for management practices was founded on a belief system that assumed a relatively static and well-ordered environment (Ackoff, 1999).

Such a conceptual framework for management practice led to the belief that sound management resided in robust systems of planning and tight controls, and that both were possible, even though early studies in cybernetics (e.g. Ashby, 1956) had identified the impossibility of effective control of large, multi-variable systems, irrespective of the quality of planning. It also espoused the belief that environmental complexity could be accommodated and successfully managed by analytical processes and that cause and effect are closely related in time and space. Perturbations could therefore reasonably be anticipated and either managed to extinction or accommodated by statistical method. This, in general, is no longer true.

This does not mean that considerable innovation in business practice has not occurred. Most will be familiar with the acronyms TQM (Total

Quality Management), BPR (Business Process Re-Engineering), JIT (Just in Time), LEAN manufacturing, among others, all claiming to be the *panacea* for one or other organisational *malaise*. Jackson (1995) refers to the 'faddish' nature of these developments, suggesting that organisations have, in the face of rapidly changing times, been particularly receptive to anything that might hold some potential for improvement or gain in a confusing and often unintelligible world. The details of these and other developments are not important. What is important is that the majority, if not all, of these have really been located within the long established scientific management paradigm that possesses certain very distinctive characteristics that make certain assumptions about the nature of the world. In the contemporary context, these assumptions are probably no longer valid.

The 'fingerprints' of scientific management are also indelibly evident in project management. The assumptions of reductionist positivism pervade the practice space of project management in general. For example, the familiar (and centrally significant) Work Breakdown Structure (WBS) in project management is an overt manifestation of reductionist thinking. This does not deny its usefulness as a means to detail and define the project in systemic terms, but the WBS disguises the essential reality that events and relationships are dynamic and fluid. This gave cause for Sterman (1992) to assert that, while the WBS, Gantt Charts, Critical Path Method (CPM) and Programme Evaluation Review Technique (PERT) are important and useful, they fall short in their ability to deal with dynamic complexity in the way systems dynamics can, for example. Jaafari (2003), Stoneham & Ainsworth, (2003), and Morris (2004) support the view that, while scientific approaches, as typified by the WBS, can expose and facilitate the management of combinatorial complexity, they are less useful in the case of the dynamic complexity that typifies the contemporary context.

## 3. Nature of the contemporary context

World economic and social events are known to have profound local impacts with sudden and to a large extent unpredictable effects. The phenomenon of globalisation, the ascendancy of the knowledge economy, a high rate of technological innovation, the development of advanced communications systems, and a growing concern with sustainable futures do not lend credibility to systems of management that are based on a belief in the capacity to plan accurately and that embody a passion for control. Projects are not

exempt from such influences. Like general management, project management is also challenged to enrich its repertoire of planning and control responses relative to a more complex world. Holmquist (2007: 46), writing in the context of project management, identifies a negative relationship between complexity and rationality, hence arguing for the need for alternative, more creative approaches to project management.

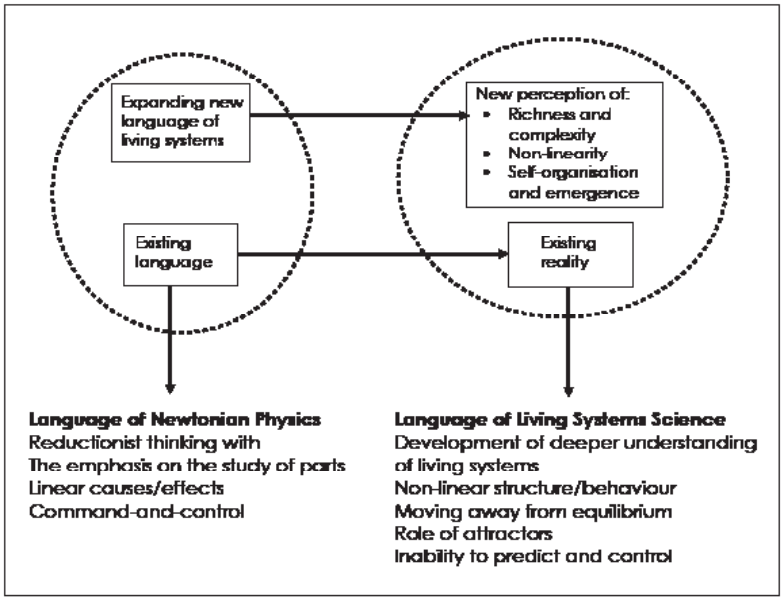


Figure 1: The impact of new language introduced by a living systems approach
Source: Dervitsiotis 2005: 941

Structures, norms and practices of management in a context of uncertain and complex socio-cultural and environmental influences require acknowledgement of the need for a paradigm of management that is increasingly 'process-based' rather than based on the all-too-familiar mechanistic 'rationalist' (or control-oriented) prescription that typifies the experiences of many. Dervitsiotis (2005: 941) speaks of the need for a 'new language' (summarised in Figure 1) as a vehicle to enable new thinking about the practice of management, so as to provide the means for the liberation of creative collective energy in the resolution, and management, of the complex problems. This language characterises a shift from that which is associated with the assumptions of predictability and

certainty to that which focuses on assumptions of movement and uncertainty. As such it facilitates a dialogue about the nature of management itself in a complex and changing world. This language also typifies the shift from scientific paradigms of management to systemic paradigms of management.

Previous work (Taylor, 2004) has summarised the development of management thinking in relation to the evolving socio-economic context in which that thinking was developed. Assumptions of relative predictability have had to make way for assumptions of relative unpredictability; assumptions about the nature of control and capacity to exercise control have had to be reconsidered; assumptions about unity of organisational purpose have had to make way for the understanding of diverse perspectives and individual consciousness,and assumptions about relative individual and organisational isolation from a broader socio-economic environment have had to make way for organisational integration into the broader socio-economic environment. Inherent in each of these assumption shifts is that which also defines complexity and the complex. These emphasise a management that can increasingly comprehend the dynamic interplay between individual, organisation and society at large. Contemporary reality is thus characterised by the descriptors usually associated with systems thinking and complexity theory, namely the unpredictable, unintended consequences, positive and negative feedback loops, non-linearity and emergence, to name a few. In brief, complexity cannot be understood and managed by analysis alone. Nor can responses be enacted by decree or reduced to codes, rules, policies and procedures, however well-intended those may be. This distinguishes the complex from the complicated.

That which is 'complex' differs from that which is 'complicated' in the sense that the complicated can be codified in terms of rules and procedures and consequently managed by those rules and procedures (Cilliers, 2000: 41; Richardson, 2008: 19). As a system of concern expands, it is increasingly difficult to translate from the 'complex' into the 'complicated' and hence also less easy to predict the behaviour of that system. Similarly Kurtz & Snowden (2003) and Stoneham & Ainsworth (2003: 2) argue that the 'complicated' becomes 'complex' as time becomes compressed, for example through fast tracking approaches that serve to accelerate feedback within systems that cannot cope with such effects.

Kahane (2004: 31) further characterises complex systems by means of three related dimensions of complexity that can be found

singularly or in combination in any problem situation. The first is 'dynamic' complexity that defines the connection time between cause and effect. For example, how close is the coupling between events, their detection and the effect of actions arising from those events? The second is 'generative' complexity that defines the degree of predictability that attends any given action. The third is 'social' complexity that identifies differing value positions between individuals and groups to be relevant to the manner in which decisions are made and action occurs. Social complexity, as defined in this instance, is embedded in the self-reflective and perceptual capacity of stakeholders. In brief, systems are defined by the way in which they are perceived by participants in them and observers of them, thus leading to multiple subjective interpretations of the world itself and the conclusion that stakeholder reality is mostly a social construct (Leybourne, 2007: 68) Objective reality is thus only a partial, limited reality. Subjective reality – ways of seeing that are also ways of not seeing - enables insight and interpretation that is driven by what is 'perceived' and how it is 'understood' by the 'observer'. This leads to multiple dynamic influences that collectively lead to inevitable instability. This view is consistent with the established view embodied in systems thinking – i.e. that systems exist mostly as interpretations of reality (Jackson, 2000), hence favouring a more process (or 'learning' or 'soft') approach to planning, implementation and control as a means to mediate complexity.

To elaborate, Figure 2 illustrates environmental influences (EA, EB, EC, ED and EE) that inform the stakeholders (designated SA, SB, SC and SD). These influences may emanate from within the project and its immediate environment or they may emanate from outside the project boundaries as is the case with ED and EE in Figure 2. While these influences facilitate experiences of practical, tangible change, they can also dynamically affect the relationships and perceptions of stakeholders of each other and of the project itself on an ongoing (and unpredictable) basis. Any act of change, with the exception of the most trivial or the most glaringly obvious (about which there is little potential for dissent), is therefore likely to be complex and turbulent. It is therefore not sensible to plan or manage complex projects as if they are simple and controllable.

It is not clear that management has adjusted to the implications of such an indeterminate, subjective world. Lewin & Regine (2000), among others, argue that the complexity inherent in real world systems defies not only the capacity to anticipate, but also the ability to effectively act or define outcomes. Conventional

organisational practice assumes that the simplification of inherent complexity is possible, when it is not. Project management itself has been broadly criticised (e.g. Morris, 2004, Koskela & Ballard, 2006, Cicmil & Hodgson 2006, Leybourne, 2007: 62, Holmquist, 2007: 46) for normative assumptions that promote systems of project governance that do not recognise contemporary reality. It is their collective view that the much-lamented failures of project management practice may not be attributable to poor practice but rather that they could be a product of operating assumptions and paradigms that are simply not fit for the purpose in all cases.

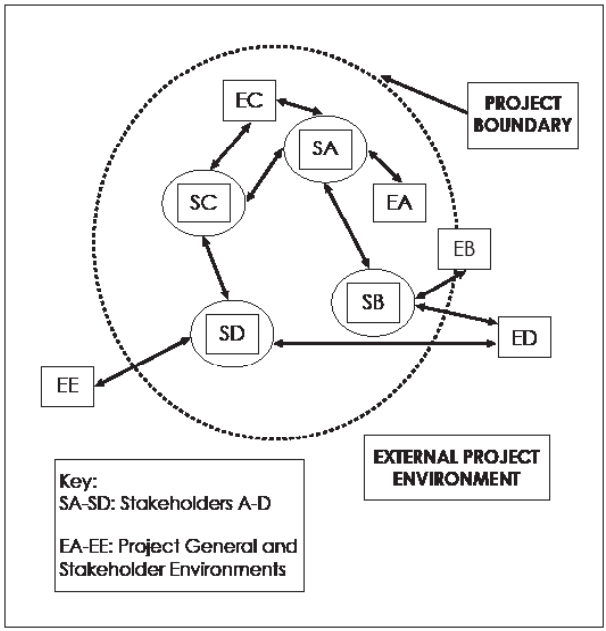


Figure 2: Schematic diagram showing mutual stakeholder and environmental influences
Source: Adapted from Laszlo 2006: 103

## 4. Systems thinking and its latent potential in project planning

Systems and 'systems thinking' is not new; nor is it new to project management where valuable systems approaches have been in use for some time (e.g. Systems Engineering). The ideas have attracted the attention of many. Considerable evolution of the

core ideas has occurred since the early writings of Von Bertalanffy (1968), when his General System Theory directed thought towards a theory of management based on explicit recognition of holism and connection. Jackson (2009) has provided a succinct outline of the major developments in systems thinking whereby the trends in thinking are explained to be a product of a recognition of the interplay between complexity and practice. In brief, his work highlights how system type and stakeholder relationships (and value positions) determine the nature of the system to be managed. This, in turn, enables understanding of inherent complexity so as to more effectively engage in planning, implementation and control activities.

What then about project management and the development of project managers? How could a more comprehensive adoption of systems approaches be useful in the management of complex projects?

In their critique of project management theory, Koskela & Howell (2002b: 293) claim that "the underlying theory of project management is obsolete." Others (e.g. Stoneham & Ainsworth, 2003: 1) claim that project management is rooted in the practices of the early industrial era. These practices are not well-adapted to accommodate complexity. Sterman (2006) concurs, as does Morris (2004) who views project management as representing an 'execution' view of projects. This is evidenced by the vocabulary of project management that reflects the language of Newtonian physics (see Figure 1). These assertions are based upon the observation that, where organisation theory is in search of new operating models that are closer to contemporary reality, so also should project management be seeking new theoretical and methodological platforms for practice that can better accommodate the type of complexity outlined earlier.

Other writers take this further. For example, Koskela & Ballard (2006) write of the diverse perspectives of a number of authors. These perspectives include those of Barnes (2002) who supports the idea that a vibrant theory of project management can evolve, but is confused at present. Morris (2000) considers project management to be predominantly about the personal experimental practices of practitioners who simply need support frameworks for those practices in order to improve their project outcomes. In other words, he does not consider that a theoretical foundation can be developed. Leybourne (2007) agrees that project management is substantially practitioner-based and that academic respectability

rests on the development of a sound theoretical foundation. Such a foundation would (at least) recognise a move away from positivist considerations to a more interpretive epistemology. A more radical perspective is that of Jaafari (2003) who claims that project management faces 'obsolescence' unless new models are developed to deal with change and complexity. Cicmil & Hodgson (2006: 119) also identify the considerable eclectic but 'noisy' discontent that exists in the academic literature about the practice of project management. Their conclusions are threefold but speak to areas of contemporary organisational concern; i.e. the project organisation as a potential site for 'oppression and exploitation'; the re-definition of that which constitutes project success to embrace notions of social and environmental justice, and the potentially transformative role of projects relative to stakeholders, stakeholder communities and societal thinking in general. One could add the views of Morris (2004), Leybourne (2007), Jafaari (2003) and PA Consulting Group (undated monograph) who collectively argue the need for a more creative reflective (or learning) approach to project management, as embodied, for example, in Soft Systems Methodology (SSM). The majority of the above-referenced authors regard the fluid, less prescriptive practice of SSM as one of the theoretical anchors that could provide project management with an alternative suite of systems thinking tools that are more suited to planning, implementation and control in complex project settings.

The critique presented in this instance is not so much about questioning the need to engage in planning, implementing and controlling, as it is about the manner in which these activities might occur in order to better accommodate complexity. This, in turn, has a bearing on the theoretical frameworks and assumptions that appear to inform the practice of a great deal of project management. Various writers have been bold enough to claim that neither planning, nor effective implementation, nor control is possible. Mintzberg (1994), referring to strategic planning, speculates on the inherent impossibility of planning; Koskela & Howell (2002b: 300) refer to Johnston & Brennan (1996) in claiming that the effective implementation of plans resides less in the explicit dictates of the plan itself, but rather in "tacit knowledge and improvisation at the operational level." Ashby (1956) holds the view (on mathematically provable grounds) that it is impossible to control large, multi-variable systems by directive process. These writers would, however, also support the view that, for management to have any meaning at all, planning, implementing and controlling all need to occur. The question is, how?

There are probably numerous potential answers to this question. As suggested earlier, concepts embodied in systems thinking are instructive and helpful. The majority of project managers would be familiar with the work of Kerzner (2001) whose seminal text on project management is subtitled "*A systems approach to planning, scheduling and controlling.*" Deriving from this, many would understand systems thinking to imply holistic thinking, on the one hand, and connectivity, on the other. Kerzner's (2001) view on systems is mostly limited to the system 'within' the management of the project itself, with some extension of the concept to include the dynamic nature of the environments within which projects are planned, executed and controlled.

It is also true to say that a view of systems that only considers holistic thinking and connectivity between system variables is a limited one. A fuller exposition should, at the very least, also include the role of positive and negative feedback, boundary definitions as defining value positions and multiple perspectives that impact understandings and perceptions of systems – i.e. the system resides in the 'changing' and 'changeable' mind of the observer, rather than in reality. In addition, a fuller understanding of the systems approach contemplates not only short-term, but also long-term impacts, thus giving status to what is sustainable, as opposed to what might represent short-term gain at long-term expense.

Aspects of systems thinking have long been embodied in the practice of project management. Jackson (2000, 2009) refers to the practice, value (and limitations) of Systems Engineering - a systems approach whose worth is mostly realised under assumptions of certainty of project objectives. This has led Jackson (2000) and Sterman (1992) to argue that Systems Engineering is a 'hard systems' approach whose value is diminished in contexts of social complexity. In a similar vein the usefulness of Systems Dynamics is promoted by Sterman (1992; 2000) as an appropriate approach to overcoming some of the limitations of linear thinking in complex systems. Using examples that define construction projects as highly complex endeavours, he reflects on the inadequacy of CPM, PERT, and similar tools of project management in dealing with the dynamic complexity inherent in even 'hard' construction projects. In summary, these developments have been valuable and useful but there is latent potential residing in systems thinking that warrants consideration. Much of this latent potential is associated with the difference between the 'complicated' and the 'complex' (Richardson, 2008: 13-15). As noted previously, the 'complicated' is capable of objective definition, albeit with some difficulty; the

'complex' is not. In the language of systems thinking, the difference between the 'complicated' and the 'complex' is that which distinguishes 'hard' systems from 'soft' systems.

Systems receive inputs, transform these and deliver outputs, and may do this well or badly. For project management this would all be familiar. Projects do indeed receive inputs, make transformations and deliver outputs that make a difference. Figure 3 illustrates the core input, transform, output relationship. It also illustrates the influence relationships that typically exist between projects and the immediate systemic environment and the overall environment beyond the immediate influence space of the project. The challenge presented by complexity is multifaceted but reduces to a number of key factors, most of which reflect the idea that reality is socially constructed (Leybourne, 2007). For project management the challenge would translate into the awareness of a problem that requires attention but with no easily identifiable solution(s); or a multitude of solutions that reflect the positions of a multitude of stakeholders. It would further be characterised by changing perspectives and positions among stakeholders that serve to shift objectives and defy control. Such projects would also require flexibility in the transformation processes engaged and an enhanced capacity to adapt the project as learning occurs, rather than strict adherence to pre-determined objectives and a rigidly controlled plan. Holmquist (2007: 51) suggests that complex projects require process skills that can survive instability and accommodate dialogue. Unlike rationalist approaches that begin with 'clear goals' and 'starting points', process approaches would support a 'starting phase' and 'more open, less well defined goals.'

In these situations, the author would propose that a useful definition of a project would be:

> *A project is a purposeful, adaptive, learning system of intervention intended to improve the achievement and further development of the agreed purpose(s) of a functioning system in an ethical and sustainable manner.*

This definition embodies the idea that complexity means that objective definition of purpose is not possible at project commencement. Similarly the means of project execution is not well defined and the possibility of changes in 'ends' and 'means' is highly probable. These characteristics define complex reality and require the engagement of management practices that form the basis of 'soft' systems thinking.

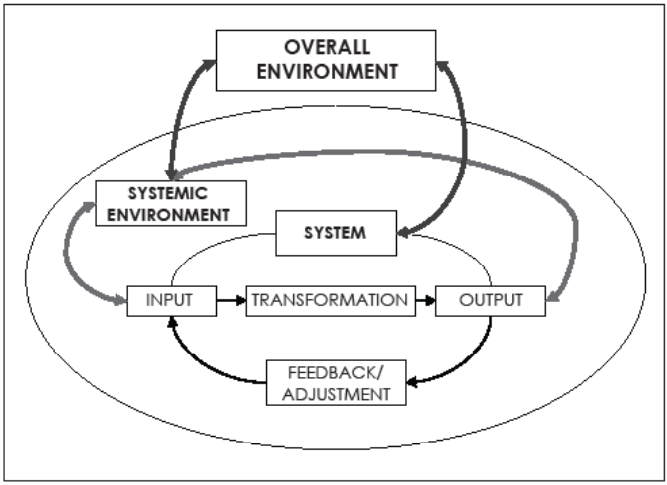


Figure 3: A general model of systems
Source: Adapted from Banathy 1996: 78

It has already been acknowledged that not all systems are of a particular type and it has not been argued that the existing practices of project management are without value. But it is so that the research opinion referred to identifies areas in which project outcomes are sufficiently less than satisfactory. These opinions also suggest that there are planning and control methods embodied in systems thinking that are under-utilised in the practice of project management. Foremost among these is Soft Systems Methodology (SSM). The real immediate issue is how, from among the range of much used (and little used) systems methods available for project planning, can an informed choice be made in order to determine which method will best address the specific project planning challenges?

In an attempt to consolidate thinking that acknowledges systems thinking as a basis for effective planning, Flood & Jackson (1991: 42) have produced a matrix, partly reproduced and adapted in Figure 4, of situation characteristics that identify two key dimensions:

- The nature of the system, and
- The nature of the participants in the system, from a perspective of the nature of the relationships between them.

For example, Figure 4 shows that a system could be defined to be Simple/Unitary (SU), Complex Unitary (CU), Simple Pluralist (SP), *etc*. Such categorisation enables an informed choice of the approach

to be engaged in the planning of interventions, so that the chosen approach recognises the essential characteristics of the system of concern. Space does not permit a full exposition of all dimensions of the matrix contained in Figure 4, but even limited explanation indicates how the matrix could guide decision-makers towards an appropriate planning approach.

Hence, this typology may be used to describe an approach to defining the system of concern so that intervention can be considered in an appropriate, more effective manner.

Where Figure 3 assists in understanding those factors that comprise and influence system behaviour at a fairly crude level, Figure 4 enables an appreciation of the extent to which diverse stakeholder relationships are relevant to any planning which might follow and which methodologies would be most relevant.

<table>
<tr><td>PARTICIPANT CHARACTERISTICS<br>SYSTEM TYPE</td><td>UNITARY (meaning essentially consensual)</td><td>PLURALIST (meaning divergent but reconcilable)</td><td>COERCIVE (meaning uncompromising differences)</td></tr>
<tr><td>SIMPLE (typically well defined objectives with or without complicated interactions)</td><td>Systems Analysis<br>Systems Engineering<br>Operational Research</td><td>Soft Systems</td><td>Critical Systems</td></tr>
<tr><td>COMPLEX (typically many variables complex interactions)</td><td>Systems Dynamics</td><td>Soft Systems Thinking</td><td>Post-modern Approaches</td></tr>
<tr><td colspan="4">PLANNING INTERVENTION DEFINED BY SYSTEM CHARACTERISTICS THAT INDICATE THE POSSIBLE TOOLS AND TECHNIQUES APPROPRIATE TO THE SYSTEM OF CONCERN</td></tr>
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Figure 4: Classification of system types and participant characteristics so as to inform identification of dominant and subservient systems for more effective change intervention
Source: Adapted from Flood & Jackson 1991: 42

Traditionally practised project management is broadly located in the 'SU' 'zone' of the matrix shown in Figure 4. The adoption of such a planning approach in the management of complex projects that also have ill-defined and changeable stakeholder objectives may well contribute to project time and cost overruns. Complex projects are usually of such a nature as to be located in the 'SP' or 'CP' area of the above matrix. This implies the recognition of complexity and stakeholder diversity as being endemic to such projects and hence a recognition of the need to adopt 'learning approaches' to change. For example, Checkland's (1993) Soft Systems Methodology (SSM) provides a framework for planning and implementation that

recognises complexity as well as the shifting perspectives that typically form part of the project and therefore have consequential effects for project management.

Change has never been easy. Knowing what to change and how, especially in the real world of diversity and difference, is complex. Deriving from the core ideas presented, it appears that a responsible approach to large-scale change is one whereby:

- Project planning considers and maps the nature of the system of concern;
- Project planning recognises that more than one system of concern might exist and that interventions for improvement may not be very effective if undertaken at a technical level only, without understanding the characteristics of the system of concern;
- Project planning seeks to secure points of maximum system 'leverage' for maximum advantage;
- Project managers recognise that systems thinking hold latent potential for an improved definition of the nature of the system of concern leading to better selection of appropriate planning tools and implementation practices, and
- Project management of complex projects accommodates the essential characteristics of process approaches that seek to actively learn and adapt goals and purposes so as to recognise that actions have both technical and perceptual consequences that give rise to the need to continuously reframe and redirect projects as they progress.

Projects are change interventions, very often undertaken in complex, dynamic environments. The tools and techniques to understand these environments and to map, model and simulate product and process, already exist. Rationalist competence that derives from scientific management (and forms the basis of the PMBOK) needs to be considerably augmented with process competence that is embodied in relatively unexplored areas of systems thinking. This signals the need to learn from the realities of practice and to look to build an alternative theoretical platform for project management that is more aligned with the complex, uncontrollable real world.

## 5. Systems thinking and its latent potential in project implementation and control

In their article on the management of complex development projects, Schwaninger & Koerner (2000: 8) have identified three organisational levels at which project control is exercised, for differing purposes:

- The organisation itself whose concern is a normative one, that is essentially 'sustainability seeking';
- The project for which the organisation carries responsibility where the concern is a strategic one that seeks to achieve 'effectiveness', and
- The sub-projects (or tasks) that cause the project to be realised where the concern is one of 'efficiency'.

As Schwaninger & Koerner (2000: 8) point out, the exercise of these three layers of control as part of a unitary control system is likely to be ineffective in complex projects. Such ineffectiveness derives from the essential nature of hierarchical systems whereby decisions required from the top become backlogged, and the problems encountered during operations do not have fluent passage up and down the hierarchy. This becomes a vicious spiral whereby problems accumulate in the system and resolution is deferred with detrimental effect.

Similarly, Koskela & Howell (2002a: 9) reflect on the need for more localised and proactive control systems. These, in turn, imply more empowered coalface personnel. In their view "the two lower control levels are geared towards learning and knowledge creation whereas the upper level takes care of the time-cost issues of the whole project."

These views represent nothing less than an articulation of the principles of the self-organising system as encapsulated in the Viable System Model (VSM) described by Beer (1985). It is useful to briefly explain the essential characteristics of self-organising systems and then to translate these into the VSM in order to accommodate the three levels of control identified by Schwaninger & Koerner (2000: 8).

Systems can indeed self organise. This is not new, nor is the concept limited by circumstance or context. Lewin (1992), for example, reflects upon the inherent, though seemingly mystical capacity, of complex systems in general to gravitate towards certain states, defined by the existence of certain strange attractors. Order and

orderliness, attributed to such strange attractors, is that which serves to bound the system and to define the range of possible states that it may adopt without external intervention.

The observation of a wide range of natural and social systems has confirmed the capacity for self-organisation. The process of natural evolution over time has illustrated the adaptive capacity of systems in the absence of overt control. Organisations have, however, demonstrated only limited capacity for the absorption and practice of self-regulation. The idea has been viewed as theoretically appealing, but dangerously impractical. Much of the perceived danger lies in the discomfort associated with less control, notwithstanding recognition that large, multi-variable systems defy control. Semler (1994) actively built the self-organising enterprise. Organisation 'happens', despite inherent complexity and notwithstanding intended controls. Adaptation to changed environmental circumstances also 'happens', specifically (and most significantly) driven from the bottom up.

In a certain, albeit mechanistic, sense, Total Quality Management (TQM) and the quality movement, in general, have recognised the significance of the so-called 'bottom' as that area from which adaptation and change might occur. Certain paradigms of leadership have also afforded central status to this. Greenleaf's (1991) book, *The Servant as Leader*, for example, explains the apparent paradox of the leader in the service of subordinates, hence to invert the traditional thinking about leaders, followers and decision-making. Senge, Kleiner, Roberts, Ross, Roth & Smith (1999) have also written about leadership as the collective act of a community in the determination of its own future. These are concepts of (and about) self-organisation. Prevailing paradigms of organisation are open to challenge, and are being challenged, not by new knowledge, but by a rediscovery of the 'old' and by an observation of the natural order of things that have long been ignored or overridden. Human attempts to subvert and manage natural phenomena have proven to be damaging, if not subversive of social, environmental and organisational well-being.

Control need therefore not be located at the top, but may be distributed in the belief that such distribution will lead to more locally relevant solutions more quickly. This implies a system of control that devolves power from the overall organisation to project and sub-project levels, respectively. Beer's Viable Systems Model (VSM) enables each project and sub-project element to be defined as a control system in its own right. Such a localised control system enables

the project membership to define direction and exercise control in terms of what needs to be done, rather than in strict observance of what was originally planned, and duly ordained from above by a project manager who is usually sufficiently removed from the action so as not to have complete clarity of judgement. Figure 5 illustrates the essential ingredients of the VSM. The VSM can be criticised for simplifying the potentially illogical and counter-intuitive nature of human behaviour. The essential message in Figure 5, however, is that each level of control in projects, including the relationship with the commissioning organisation, should be self-regulating. In brief, each level of control (i.e. organisation, project and sub-project) embodies all the essential characteristics of an effective and complete control system, i.e. the control system has recursive characteristics. Each level would therefore display the characteristics and components of every other level, i.e. capacity to monitor the environment, take operational decisions (as appropriate to the level in question) and implement these, pass information up to the next level in the system and receive information from the next level, and so on. By such a process and adoption of the principle of self-organisation, decision-traffic in the system is reduced and control is more effective and direct.

Under such a scheme, the role of project manager is exercised at the interface between the various control levels so as to regulate information and communications flows at those points.

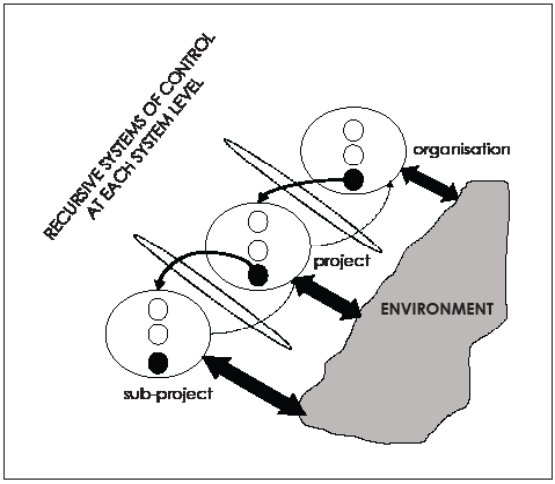


Figure 5: Graphic depiction of the principles of the Viable Systems Model for the control of complex systems
Source: Adapted from Schwaninger & Koerner 2000: 9

## 6. Educating a profession for change

At the outset it was stated that this article would close with some reflections on the state of project management education and that this would also serve to draw conclusions emanating from the major arguments presented in this article. Jafaari (2003) ventures to suggest that the approach to project management as embodied in project management courses and literature is of limited value in the face of accelerated change and increased complexity. This probably overstates the situation but highlights the need to reflect on alternative approaches to project management that might go some way to address the prevalent concerns about the adequacy of practice relative to contemporary complex reality.

In the first instance, it has been stated that project management has been heavily influenced by the scientific approach to planning, implementation and control. As such, project management, as conventionally understood and practised, is deficient in the art of accommodating the realities of the real world. This deficiency is believed to contribute to project failures and to give cause for reconsideration of the theoretical foundations that underpin project management. The contemporary era is typified by complexity and profound uncertainty. The capacity to deal with these realities needs to become part of the knowledge domain of practising project management. Successful outcomes are unlikely to be achieved by analysis alone. Nor, it has been argued, is improvement likely to be the product of redefining and refining practices within old paradigms by using existing tools and techniques.

Secondly, project management needs to become adept at understanding the nature of the planning space in which it seeks to bring about change and implement projects. The careful identification of the nature of the system of concern can serve to validate the relative usefulness of 'rationalist' or 'process' approaches (or a suitable combination of both) to planning according to the levels of complexity inherent in the project. Systems thinking holds a useful array of planning tools, many of which are not utilised in the practice of project management but are theoretically sound and practically robust. The management of the system 'within' the project is laudable, but there is also the need to be able to intelligently interrogate the broader ramifications of project activity, not only in the short term, but also in the long term. Projects exist in an input/output relationship with their environment, exacerbated

by the perceptual influences that generate added complexity especially in projects with highly diverse stakeholder groupings and lack of initial clarity of project objectives.

Thirdly, a growing concern with the consequences of uncertainty as affecting management planning has resonance for how control relative to plans is exercised. It is in this sense that the case for self-organising systems, as exemplified by the VSM, is made. The capacity to respond to change quickly and locally is a common theme in the literature of strategic management. Hierarchical forms of management have outlived a great deal of their usefulness. The same is true of project management where complex reality requires that project control systems be designed to ensure local viability of product and process in response to environmental changes. Some of this capacity is undoubtedly already part of project management practice. Systems thinking, through the VSM, suggests that this can be extended and can contribute significantly to the more efficient management of projects. Logic indicates that this ought to be so.

Fourthly, our current world is almost certainly not going to be the world of tomorrow. The future is profoundly unknown and unknowable in a finite sense. Complex projects entail an anticipation of an improved future, yet the capacity to know the future is limited, as indeed is the capacity to fully comprehend the impacts of changes during the life of a project. It has therefore been argued that project management requires a 'learning capacity', as embodied in the methods of Soft Systems Methodology (SSM), for more effective results in an uncertain world. The potential to simulate projects through systems dynamics also exists as an aid to the exploration of (and learning about) potential project futures, but does not typically enter the decision frames of project management.

In summary, therefore, project managers need to be technically astute, as indeed good project managers typically are. They also need the insights and foresights that are central to the creation of better futures in a changing world. Being exclusively 'technicist' is probably not good enough in a world that expects much more of its decision-makers and change managers. This brings with it huge responsibilities for project managers relative to society at large.

The paradigms of business are changing. Briefly, it is time to educate the profession of project management for change and for more appropriate, dynamic forms of practice in a complex world. In so doing it is also probable that the theoretical foundations of

project management will be expanded and strengthened so as to capacitate the profession to respond more convincingly, especially in conditions of complexity and uncertainty.

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