A systemic analysis of the electronically integrated physical education learning organisation

Ian R. Haslam
School of Physical Education
NIE/Nanyang Technological University

Abstract

The purpose of this paper is to explore the impact of a physical activity information system (PAIS) on the physical education learning organisation (PELO). Firstly, dynamic models of the single and double loop systems of learning will be developed from the mental models of experienced physical education teachers in the Singapore system. These inferences and assumptions will then be converted into a systems dynamic model using qualitative equations created by the 'ithink' Analyst programme 5.0. The single and double loop systems will then be converted to the PELO. The PAIS dynamic framework was created in a similar manner and then the PAIS was integrated with the PELO. Simulations were then conducted to determine the impact of unexpected change and intellectual capital on the PELO, unexpected change on explicit knowledge capital and unexpected change on the paradigm quality of the PELO.

Introduction

The health of the nation is at risk as long as its next generation of citizens have an indifferent attitude to the role of physical activity in their daily lives. In the USA high school graduates will have watched between 15000 -18000 hours of television in contrast to only 12000 hours in school (U.S. Department of health and Human Services, 1996). In Singapore the First Deputy Prime Minister, Mr Goh Chok Tong remarked on the disturbing trend toward obesity in children and youth and predicted that if the trend continued one out of every five Secondary 4 boys would be obese (Straits Times, 16 March, 1990). In like manner, Dr Tay Eng Soon (Then the Senior Minister of State for Education) noted that 18% of Primary 6 boys suffer from obesity (Straits Times, 19 September, 1991). The problem of passivity among school age children is a'global problem that must, in part, be resolved during the child's growing years. A report from the US Surgeon General (1996) on Physical Activity and Health emphasises the public health importance of a physically active population and states that, "we must accord it the same level of attention that we give other important public health practices that effect the entire nation". The report goes on to argue that physical activity is an integral component of the "public health challenge for reducing the national burden of unnecessary illness and premature death". Tremblay (1997) thus concludes that because school programmes reach virtually all children throughout their growing years it is the school physical education curriculum that has the potential to assume the role of the "prevention hospital of tomorrow".

PAIS conceptual framework

Ironically it is the pervasive nature of information technology (IT) in modern society that has contributed to increased levels of passivity among Singaporean children and youth but it could be IT that helps to solve the problem. A physical activity information system (PAIS) has been developed to electronically augment the limited time given to physical education in the local school curriculum (Haslam and Smith, 1998). An argument has also been made that the PAIS could be more than an elaborate computer assisted instruction initiative but that it could make knowledge management and thus quality control that much more efficient (Haslam and Aplin, 1998). A more detailed discussion of the PAIS is outlined elsewhere (Haslam and Aplin, 1998, Haslam and Smith, 1998) but succinctly the PAIS is a daily quality physical activity programme, which is provided through the school's physical education WWW site. Technologically one of its intriguing features, which will make it unique in the world, is its use of 'video on demand' lesson clips graphically illustrating the learning activity for the day. From a management point of view the Web delivery makes the physical activity lessons 'site independent' which means that a student can undertake their physical activity lesson anywhere or at anytime. Further, the PAIS brings both 'value-added features' to the provision of physical activity services in schools as well as specific 'quality assurance' components, which are electronically managed.

Purpose of the project

The purpose of this study is to create dynamic frameworks to simulate how the physical education department will respond to changes brought about by a Physical Activity Information System. Learning organisation theory will be used as an operational basis for the project, specifically the theories and assumptions behind single and double loop learning (Argyris and Schon, 1996).

Organisational learning

Stages of organisational learning are a popular construct in the learning organisation literature. Bartunek and Reed (1992) discuss the notion of first and second order learning; Burgoyne (1995) thinks in terms of formation learning, adaptive organisation learning and creative process learning while Palmer (1979) introduced zero, I, II, III and IV learning. The basis of this project comes from the hierarchical framework of Argyris and Schon (1996) who use the terms single and double loop learning processes.

> By single-loop learning we mean instrumental learning that changes strategies of action or assumptions underlying strategies in ways that leave the values of a theory of action unchanged. p.21

An example could be when a PE teacher identifies defective equipment and conveys that information to colleagues who make the necessary changes. These changes according to Argyris and Schon are mediated by organisational inquiry and connected by a single feedback loop, which attempts to close the gap between observed behaviour and required behaviour. By double-loop learning the authors believe that:

> Learning results in a change in the values of theory in use, as well as in its strategies and assumptions. The double loop refers to the two feedback loops that connect the observed effects of action with strategies and values served by strategies. p.21

Double loop learning can occur at an individual level when a person change their value orientations to an issue based on information or experiences acquired by the person. It can also occur at an organisational level when individuals question assumptions of the theories in action in use by the organisation and make changes. One would think that out of the process of organisational learning would emerge organisational knowledge, which would in turn lead to increased learning. If this process were formalised then it should increase organisational effectiveness in achieving and sustaining their curriculum goals and objectives.

The learning organisation is able to create a work environment where people are able to expand their capacity to achieve their potential in work and life. It is a place where attitudes and value assumptions can be challenged and changed in a stress less environment. It is also a place where people learn how to learn in groups (Senge, (1990, 1994).). According to Senge there are five disciplines to be mastered by the learning organisation and these include systems thinking, personal mastery, mental models, shared vision and team learning. Perhaps the most compelling challenge is to master the discipline of *systems thinking* for it is systems thinking that integrates and expands upon the other disciplines in a specific organisational context.

Systems thinking is derived from the field of system dynamics and provides a conceptual framework grounded in a body of knowledge that helps make organisational behaviour more predictable. As Senge (1990: p.12-13) states:

> At the heart of a learning organization is a shift of mind – from seeing ourselves as separate from the world to connected to the world, from seeing problems as caused by someone or something 'out there' to seeing how our own actions create the problems we experience. A learning organization is a place where people are continually discovering how they create their reality.

Systems' thinking is the art and science of making reliable inferences about behaviour by developing an increasingly deep understanding of underlying structure (Richmond, 1994 p.5). It is integral to the process of systems dynamics, which has been used in various settings. Industrial and economic dynamics appears to have been the main focus of attention and in fact the area from which the main body of literature has emerged. Forrester, (1961) featured a dynamic analysis of modern business problems along with policy discussions of a production-distribution system. Forresters's work (1968, 1975, 1989) is seen to be seminal and is cited in most serious attempts to trace the development of the field. There have been a number of projects on the subject of growth and global modelling (Meadows, Richardson and Bruckmann 1982); in the area of management including organisational and market models (Morecroft, 1984, Sterman, 1989). The next logical growth area would have to be the research literature that seeks to question the validity of modelling that supports the conceptualisation and formulation of models (Forrester, 1980, Richardson, 1986). Of particular interest to this project is the area of modelling for learning using systems thinking and organisational learning. Morecroft (1988) describes models and methods for using systems thinking to enhance learning for both individuals and organisations. He uses group process techniques and management flight simulators for capturing and simulating mental and formal models.

A dynamic framework for a physical education learning organisation (PELO) was created based on models of single and double loop learning organisation theory (Stewart, 1997). Similarly a dynamic framework for the PAIS has been modelled and then simulations were conducted to test the assumptions in both models serve to validate the dynamic frameworks (Haslam, 1998). The physical education work environment responds to changes in the 'quality of its intellectual capital' and there ability to cope with 'unexpected changes' in their workplace.

Integrating the PAIS and PELO Dynamic Framework

The interplay between dynamic feedback loops that integrate the PELO and PAIS will demonstrate the impact of PAIS on PELO. The relationship is based on the notion that the 'availability of information technology' will effect the 'selection of problems' by the organisation's 'intellectual capital'. In short, as the problems related to PAIS are tabled for discussion they become either 'anomalies' or 'solutions' which may or may not (depending on the nature of the organisation as well as its IC) effect the 'paradigm quality' of the system. This, in turn will enhance its ability or inability to create 'explicit knowledge capital'. Knowledge capital would manifest itself in the form of a more positive attitude to physical activity, increased knowledge about physical activity and increases in fitness and skill levels among the student body. Figure 1 illustrates the PELO dynamic framework with the PAIS dynamic framework. The key variable for consideration from the PAIS is the **'availability of digital resources'**. These include the formal and informal availability of digital resources in the organisation. The system then responds to the availability of digital resources through its intellectual capital.

The Intellectual Capital (IC) Index

In quantifying a physical education department's IC index it would be naive to think that an ascending linear growth of IC within an organisation would reflect the organisations ability to learn. It seems more reasonable to think that as change occurs in the work place (particularly knowledge-based change in the physical education work place) then there is likely to be a sudden upsurge of learning. This might then be followed by a period of consolidation and a plateau of organisational development could represent refinement of new learning. In other words a 'stage wise' adaptation of the system rather than an ascending linear process might be more appropriate (Figure 2). Actually, this assumption is not unusual in the learning theory literature as it is expounded by Piaget's theories of cognitive learning.

Single and double loop learning systems

The learning process manifests itself in the single and double loop systems, which were the bases of the PELO's dynamic framework. The 'rate of solution' and changes in the levels of the 'paradigm quality' actually reflect changes to the single and double loop systems respectively.

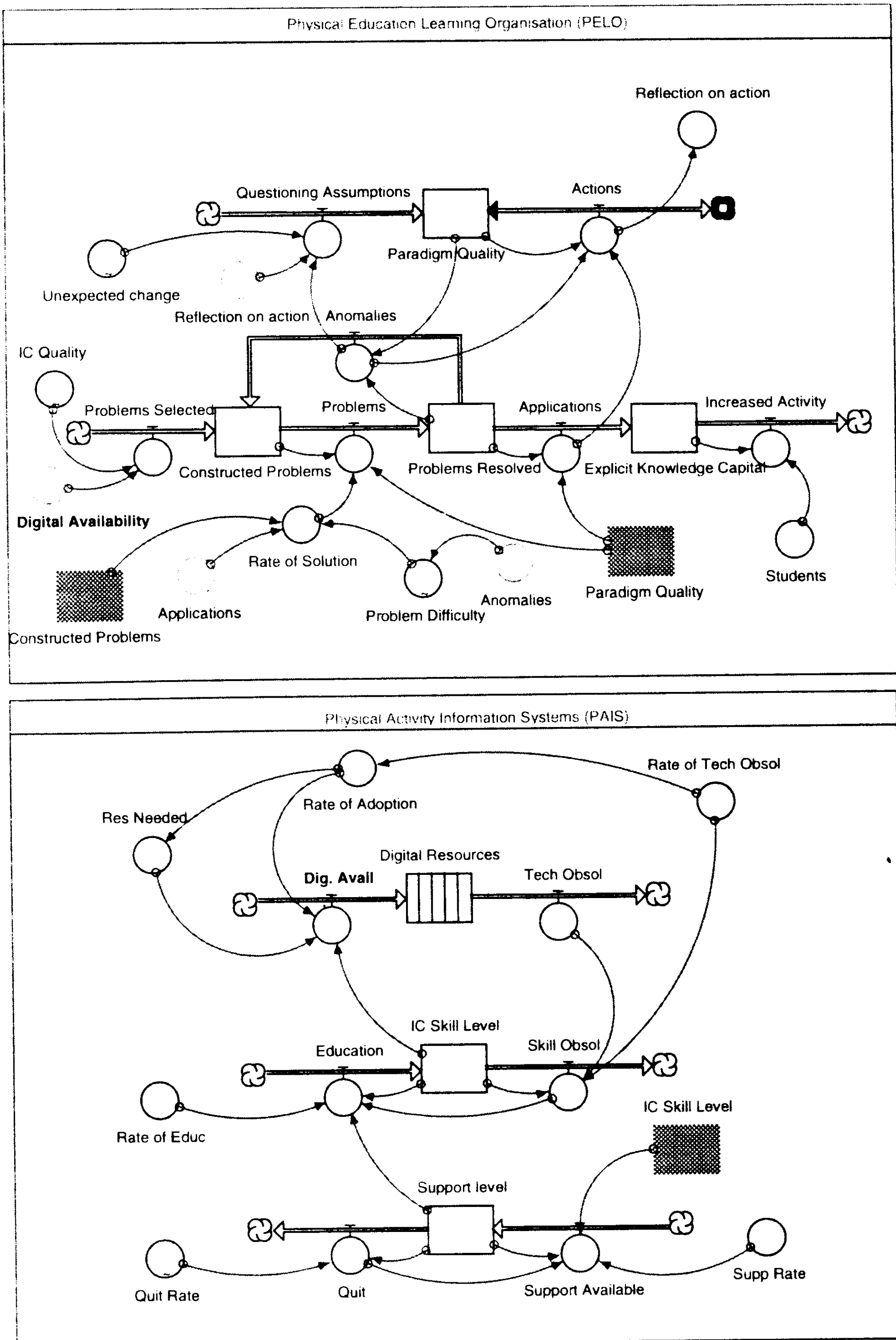

Figure 1 Integrating the PAIS system with the PELO dynamic framework

Most organisations are interested in the development of 'explicit knowledge capital', which in the case of the physical education department would be based on improved value orientations to physical activity among all students in school. In the PELO dynamic framework the main variables are 'IC quality' and 'digital availability' (DA) which feed into the process of 'problem selection'. Prioritising and identifying those problems, which are most important to the organisation, represents an average of the sum of these variables.

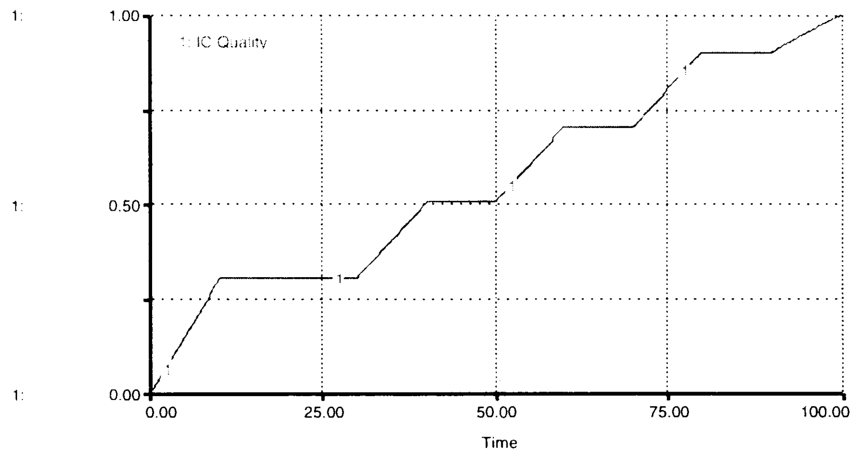

Figure 2 A Stage Wise Ascending Development of the Quality Intellectual Capital

The effect of unexpected change (0.25) and IC (0.0-1.0) in the PELO

Figure 3 shows the relationship of 'problem selection' to the 'paradigm quality', 'rate of solution' and 'knowledge capital'. It is evident from the graph that when the 'IC quality' of the organisation increases and unexpected change is held constant (0.25) then there is a steady increase in 'explicit knowledge capital'. In like manner the 'paradigm quality' and the 'rate of solution' also demonstrate a similar climb throughout the simulation. What is most interesting, however, is the particularly steep increase in the 'selection of issues'. Probably the single most compelling feature of the notion of organisational learning is the ability of the organisation to select those issues most relevant to the creation of explicit and implicit knowledge capital within the organisation. In other words to select the issues and challenges it feels might result in enhanced performance. In the graph the 'selection of issues' most closely mirrors the increase in 'explicit knowledge capital' and presumably an increase in organisational performance. Both 'knowledge capital' and 'problem selection' and to a certain extent the 'rate of solution' follow similar peaks and troughs, which can be said to roughly, correspond to the spurts and plateau of the 'quality of intellectual capital' in the organisation.

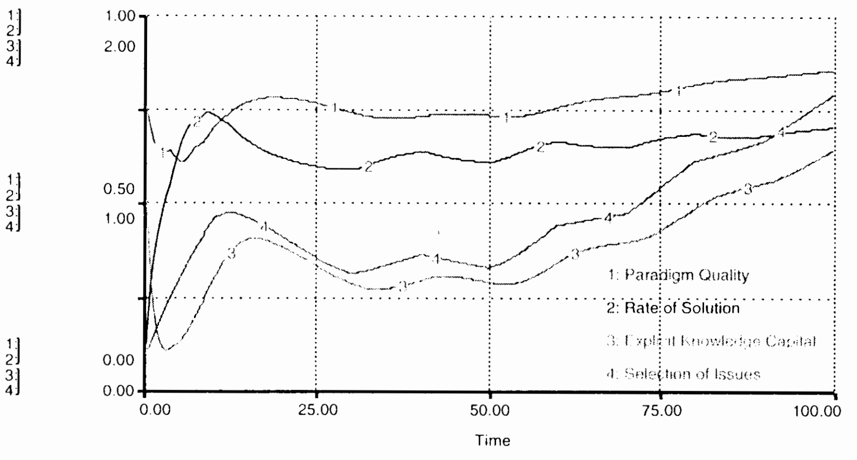

Figure 3 The effect of Issue Selection when Unexpected Change is set at 0.25 and IC Quality is a stage wise graph

The Effect of Unexpected Change on Explicit Knowledge Capital

It might be of interest to explore the level at which 'unexpected changes' would cause the PELO dynamic framework to falter and the creation of 'explicit knowledge capital' to decline. That is to say, what might happen to the system at increasingly higher levels of unexpected change? Figure 4 compares the effect of increasing levels of 'unexpected change' on the creation of 'explicit knowledge capital' when the 'intellectual capital' is held at a constant of 0.25. The graph illustrates that when the 'IC quality' is constant and the 'unexpected change' confronting the organisation increases then the 'knowledge capital' created by the organisation in each simulation is lower than the previous simulation. What is also curious though is that in each case after reaching a trough between three and six months there is a steady increase in the 'knowledge capital system' throughout the year. This could be explained by the systems ability to 'reflect on its actions' and 'question its assumptions' leading to an increase in the 'paradigm quality' which in turn could effect the 'knowledge capital' created by the organisation.

The Effect of Unexpected Change on the Paradigm Quality

The 'paradigm quality' exhibits a similar response to changing levels of 'unexpected change' in the system (Figure 5) as the creation of 'explicit knowledge capital'. At the lowest level of unexpected change (0.0) the 'paradigm quality' functions at an apparently high level. Then at the highest level of 'unexpected change' (1.0) the 'paradigm quality' functions initially at a much lower level but then through a series of troughs and spurts appears to respond positively. It could be deduced that perhaps the system needs high levels of change to be challenged toward higher and deeper levels of 'paradigm quality'. An initial response to change might be short-lived and somewhat superficial but as the system is constantly challenged with higher level issues to resolve it becomes more adept at identifying and then resolving increasingly more complicated issues. This not only reinforces the procedures the organisation uses to make this happen it also enhances the tacit knowledge through enhanced levels of problem finding.

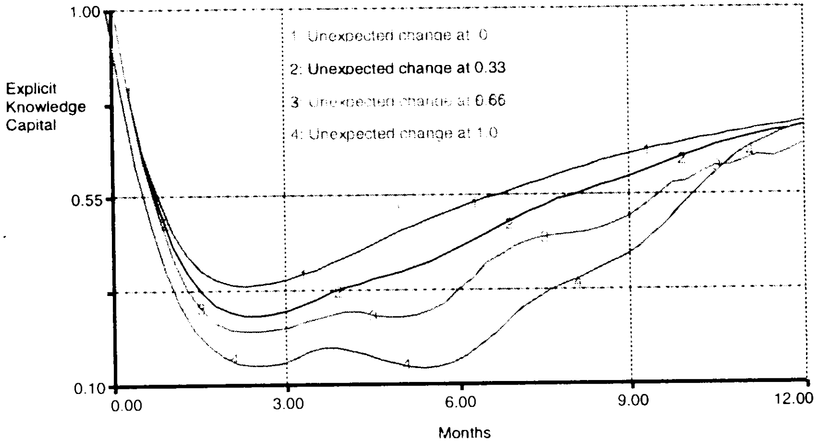

Figure 4 Increasing levels of unexpected change on explicit knowledge capital

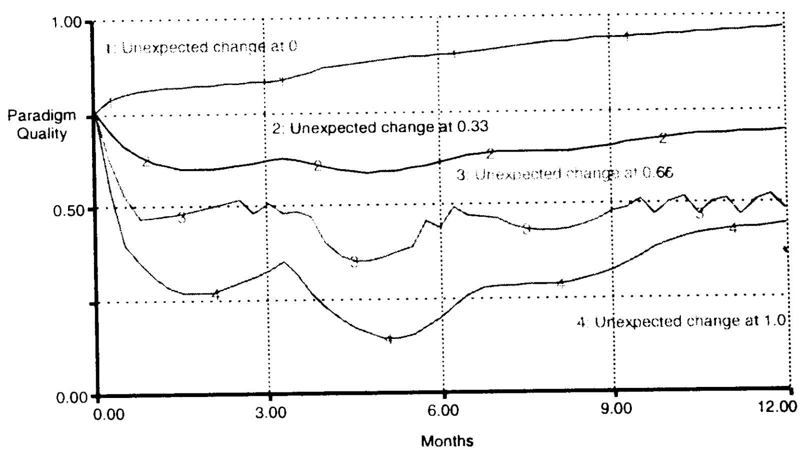

Figure 5 Increasing levels of unexpected change on the Paradigm Quality

The relationship between the creation of 'explicit knowledge capital' and the 'paradigm quality' of the PELO when 'unexpected change' is fixed at 0.5 reveals a pattern that suggests the system might have adaptive capabilities (Figure 6). That is to say, after an initial systemic shock because the level of 'unexpected change' is greater than the level of 'IC quality', which is set at 0.25.

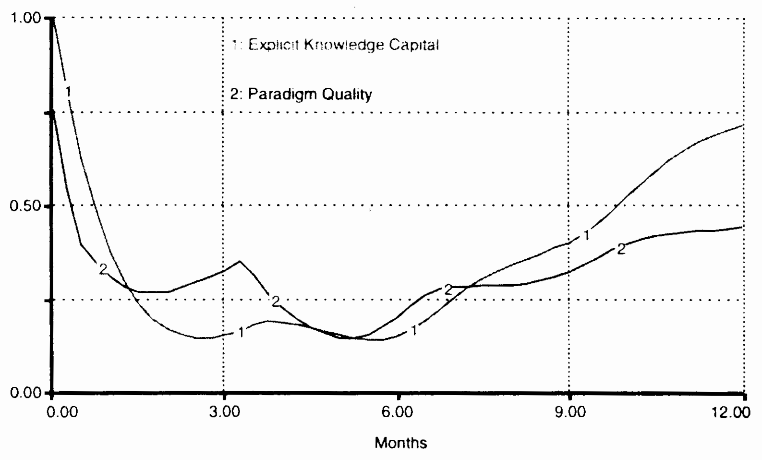

Figure 5.6 Paradigm quality and explicit knowledge capital when unexpected change is set at 0.5

The system responds positively as it 'reflects on its actions', 'questions assumptions' and deals with its relationship between the 'rate of solution' and the 'anomalies' in the system. In turn its 'knowledge capital' is enhanced. The turning point in this simulation appears to be at the third month where the paradigm quality recovers from the initial shock and reaches a momentary peak. Thereafter it drops below the level of the 'explicit knowledge capital', which is created following the learning process occurring in the organisation. It is worth noting that an unexpected change in the magnitude of 0.5 has about a 6-month impact on an organisation with an 'intellectual capital 'of 0.25. Similarly, 0.25 would not be considered to be the most effective of IC capital quotients in fact this level could be considered as a relatively low level of IC with perhaps 1.0 being the highest. Measuring and quantifying IC quotient has been addressed by a number of authors in recent years including Stewart (1997), Sveiby (1997) and Roos (1996). Their work should probably used in future action research using these dynamic frameworks.

The creation of 'explicit knowledge capital' in the form of increased participation in physical activity is probably the main goal of PELO. The key to sustaining the growth of ***explicit*** knowledge capital is a function of an organisations ability to cultivate its ***implicit*** knowledge capital. In the case of the PELO the implicit knowledge capital of the organisation resides in the 'paradigm quality' stock. Implicit knowledge is created from experiences and challenges people have as well as the prevailing attitude to challenge and innovation (Nonaka, 1995).

Conclusions and recommendations

The purpose of the project was to create development of dynamic frameworks that could be simulated to explore the impact of a PAIS on the physical education work environment. The assumptions and theories on which the frameworks were developed could then be used in a long-term research programme that looked at the strategical response of the PELO to PAIS.

Increases in the quality of IC positively enhance the organisation's paradigm quality (allowing them to identify and resolve 'wicked' issues confronting the organisation). It also increases the rate of solution of organisational issues and increases the explicit knowledge capital of the organisation. In like manner it decreases anomalies.

When turbulent environmental conditions create higher levels of unexpected change there is a delay by the organisation but then a modest improvement in IC quality. This is a deeper reaction by the organisation as they move to resolve paradigmatic issues by reflecting on their actions and questioning their assumptions. Ironically, it could be that in fact organisations like sports people require higher levels of competition (more difficult issues) to get the best from them. Without the most difficult issues the organisation would function below its potential.

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