To Main Proceedings Document

The Development of the Holon Planning and Costing Framework for Higher Education Management

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Abstract

This paper discusses the emergence of the Holon Planning and Costing Framework for Higher Education management. We briefly discuss the key concepts that underpin management of the university system in the United Kingdom. An outline of the dominant HE planning approach is undertaken and criticisms are produced to suggest that an alternative is needed. We believe most mathematical techniques used for planning can be linked with Hard Systems Thinking (HST). Therefore, the essence of HST is highlighted, and a serious weakness identified, to explain the development of soft methodologies and Soft Systems Thinking (SST). We outline the distinguishing features of SST and key characteristics of the Soft Systems Methodology. Additionally, a significant limitation of this methodology is highlighted to justify the need to combine it with the Goal/Question/Metrics methodology. The combination of these two methodologies has been called the Holon Methodology, which was originally designed as an informal software process improvement approach. We advocate the view that an informal approach to controlling and improving HE management is needed; this will empower the relevant academics and administrators. This complements the view that there is a need for a systemic approach to HE planning. Therefore, we combine the Holon Methodology (rooted in SST) with the System Dynamics technique (rooted in HST) to produce the Holon Planning and Costing Framework. An outline of the work that is currently being undertaken to establish this planning framework is given.

"I keep six honest serving-men:
(They taught me all I knew)
Their names are What and Where and When
And How and Why and Who."

(Rudyard Kipling 1912)

1. Introduction

The United Kingdom (UK) education system is evolving to meet the shifting demands of society. Over the last two decades UK employment patterns have changed significantly, and there is a need for a more highly trained and educated workforce. Moreover, this workforce must continuously update its skills to meet changing requirements of the labour market. Recognition of the environmental changes that affect the Higher Education (HE) system initiated the Dearing Report (Dearing 1997). We outline key aspects of this report for it underwrites UK government strategy for the HE system and

influences our research. Successive governments have provided most of the funding for the HE system. In the last decade or so these governments have demanded greater university accountability for public scrutiny, which has led to an emphasis on management practices. Trow (1994) coins the terms 'hard' and 'soft' managerialism which characterise the different government and university management approaches respectively. We discuss the underpinning concepts of these two forms of management.

An overview of the fundamental components of the dominant HE planning methodology that is associated with soft managerialism is provided. Galbraith (1998a) highlights the limitations of this approach to justify the use of the System Dynamics (SD) (Forrester 1961) technique. Further criticisms are adduced from the work of Simon (1979, 1976) and Ackoff (1979) to reinforce the view there is a need for a systemic approach to HE planning.

Galbraith (1998b, 1989, 1982) has developed a number of SD models over the years, which demonstrate the usefulness of the technique through highlighting its explanatory strengths, *i.e.* 'the how' and 'the why'. Furthermore, he has identified several archetypal structures (Senge 1990) that operate within Queensland University. However, Galbraith did not work closely with key stakeholders ensuring relevant problems, *i.e.* 'the whats', are examined. We consider this to be a limitation of his innovative work. The absence of stakeholder participation is considered to be a fundamental weakness of hard systems thinking when investigating social situations. SD is usually associated with hard systems thinking, but Lane (1994) argues there is a need to combine SD with a soft methodology. Soft methodologies are linked with soft systems thinking. We provide a description of the essence of hard and soft systems thinking. A brief overview of Soft Systems Methodology (SSM) (Checkland 1981) is given, for it has been argued that it should be synthesised with SD (Lane and Oliva 1998).

We will identify a significant drawback of SSM to justify the need to combine it with the Goal/Question/Metrics (GQM) methodology (Basili and Rombach 1988) which is underwritten by representational measurement theory (Fenton 1991). We will show that merging GQM and SSM gives a distinctive new soft approach – the Holon Methodology (Bell *et al* 1999b). The Holon Methodology was originally designed as a *post-mortem* approach. It identifies the problems associated with a completed software project from the perspective of the development team. Therefore, we consider the methodology to be an informal Software Process Improvement (SPI) approach (Bell *et al* 1999b). An overview of the key stages and methods of the methodology is provided. However, the method taken by Dearing (1997) to produce a vision for the HE system prompted our redesign of this methodology.

The redesigned methodology is considered to be a soft teleological approach. We outline the fundamental parts of a soft teleological approach. A weakness of the redesigned methodology is highlighted to justify the use of SD, leading into the development of the Holon Planning and Costing Framework. The Framework is used to assist in continuous planning and costing for the School of Computing, Information Systems and Mathematics (SCISM) at South Bank University. Finally, completed and on-going work using aspects of the framework are briefly described.

2. Overview of the Dearing Report

Over the last few decades, governments have commissioned major reviews of the higher education system in order to address specific challenges. In the later part of the last century there has been a significant decline of traditional heavy industries, *e.g.* coal and railway industries, and the notion of 'job for life' has diminished. However, new 'high tech' organisations have appeared which require a highly trained and educated workforce to meet present and future challenges. The shift in employment patterns and rapid technological changes have created new problems for the HE system.

Dearing (1997) was given the opportunity to make recommendations on how the purpose, shape, structure and funding of the HE system should develop over the next 20 years. He investigated the current state of the HE system and its wider context, *i.e.* its relationship with society. Dearing argued that the UK must create a 'Learning Society', committed to learning throughout life. He envisioned HE as making a distinctive contribution to the development of a learning society through teaching, scholarship and research. He derived 93 recommendations to achieve this vision of a higher education system for the learning society and many of them have been implemented.

3. Hard and Soft Managerialism

In the last decade or so UK governments have demanded greater accountability in the quality and cost of universities and that this should be available for public scrutiny. Hence, the emergence of 'managerialism' in the governance and direction of universities. Trow (1994) believes that hard and soft managerialism concepts are applied to HE institutions. Hard managerialism generally involves people from government and business who are resolved to reshaping and redirecting universities through funding formulas and other mechanisms, *e.g.* criteria to assess teaching quality. Trow contends that business models are central to hard managerialism, for they assist in transforming universities into organisations similar enough to ordinary commercial companies to be assessed and managed in similar ways. The Higher Education Funding Council for England (HEFCE) implements and oversees government policies for the HE system. Furthermore, HEFCE works closely with the Research Assessment Exercise (RAE) team and the Quality Assurance Agency (QAA). The RAE team examines the quality of research within different institutions to guide the distribution of public funds. The QAA investigates different aspects of teaching quality, which also affects university funding. We consider these bodies to be an integral part of the hard managerialism concept.

Soft managerialism involves senior administrators and appropriate academics in the universities. The soft concept views managerial effectiveness as an important component in the provision of higher education of quality at its lowest cost, and is focused around the idea of improving the efficiency of the institution. We therefore review the dominant approach to HE planning, and highlight weaknesses that question its efficacy in achieving the aims of soft managerialism.

4. The Dominant Higher Education (HE) Planning Approach

Galbraith (1998a) identifies the dominant HE planning approach that is associated with soft managerialism. The key parts of the approach are: a strategic plan; performance indicators (PIs); mathematical models; and artificial structures. A strategic plan usually entails a mission statement and related strategic aims, *e.g.* excellence in teaching and learning, which fulfils it. These strategic aims are treated separately and expressed in

terms of goals, which are assessed through the use of PIs. Furthermore, regression models and spreadsheets use the collected data for forecasting and budgeting purposes.

A university is divided into faculties each containing a number of schools or departments. Galbraith sees these groups are used as artificial structures to facilitate competition for resources at the university level. The underpinning argument is that schools in competition will optimise their efforts, thus, optimising the overall performance of their faculties. Maximising faculty performance in turn optimises the total performance of the institution, therefore, meeting government objectives that may lead to further funding.

Galbraith (1998a, 1998b) highlights several limitations with the dominant HE planning methodology to justify the use of SD. Most importantly, the strategic aims are treated separately, and related goals are individually assessed through PIs, *e.g.* a goal to increase research output may be expressed as numbers of papers in two years. However, improvements needed to ensure a goal is achieved could have an adverse affect, *e.g.* a rise in research effort may reduce teaching quality.

Ackoff (1979) contends that managers are not confronted with problems that are independent of each other, but with situations that consist of dynamic, transient and complex problems that interact with each other. He calls such a situation messes. Furthermore, he states:

> *"Messes are systems of problems, the sum of the optimal solutions to each component problem taken separately is not an optimal solution to the mess. The behaviour of a mess depends more on how the solutions to its parts interact than on how they act independently of each other."*
>
> (Ackoff, 1979)

We contend that if every faculty and school have their own mission statement and objectives then dysfunctional behaviour will arise. The notion that dysfunctional behaviour can emerge from well-intentioned actions is associated with the Carnegie school of thought, which recognises that there are severe limitations on the thinking and reasoning power of the human mind. The principle of bounded rationality was formulated by Herbert Simon as the basis for understanding human behaviour in complex systems. The principle of bounded rationality states:

> *"The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behaviour in the real world or even for a reasonable approximation to such objective rationality"*
>
> (Simon, 1979)

Furthermore, the bounded rationality principle provides a basis for developing a theory of organisational behaviour. Simon further wrote:

"Organisation theory is centrally concerned with identifying and studying those limits to the achievement of goals that are, in fact, limitations on the flexibility and adaptability of goal striving individuals and groups of individuals themselves"

(Simon 1976)

We contend that the dominant HE planning methodology used to achieve the aims of soft managerialism is inappropriate, and indeed may cause dysfunctional behaviour, because it concentrates on maximising the performance of an individual faculty/school/centre, which may have an adverse affect on others. An holistic approach is needed. Ackoff (1979) argues that effective management of messes requires a systemic approach to planning. Galbraith (1998a) proposes the use of SD as an alternative HE planning approach. Moreover, Morecroft (1985, 1983) demonstrates that the concept of bounded rationality is directly represented in feedback structure, which is central to SD. Hence, SD may prevent the emergence of dysfunctional behaviour through investigating the systemic consequences of various decisions.

5. Galbraith's SD Work in HE Planning

Galbraith (1998b) has identified many system archetypes which appear at various hierarchical levels and different parts of the university. For example, figure 1 is a causal diagram that represents research funding allocation between two competing units. The positive loops highlight that an increase in the productivity of a research unit will lead to resource gains, which enables further productivity and thus further gains. The negative loops are essentially regulating or balancing in their effects. The top negative loop highlights that a rise in the productivity of research unit A will contribute to the total research output produced by all the units. However, resources gained per individual product is reduced, which decreases the resources assigned to a unit A, which in turn reduces the productivity of A.

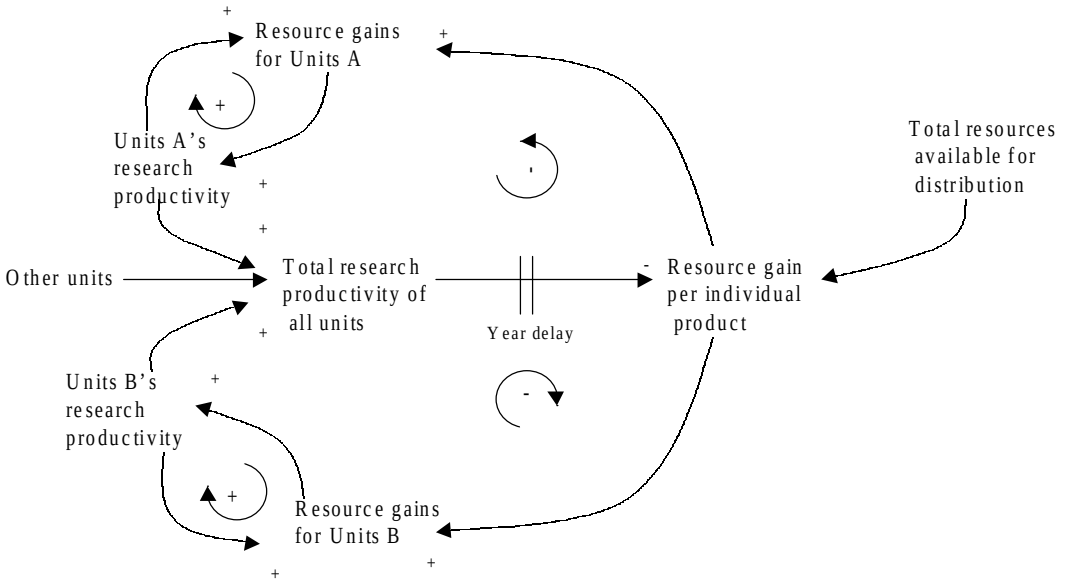

Figure 1: Causal Representation of Research Units Competing for Limited Funds (taken from Galbraith 1998b)

Galbraith sees this as a version of the 'tragedy of the commons' because there exists a 'commons' or a limited resource shared amongst a group of competing units and the units dictate their own actions in order to maximise their own gains from the common resource. The common resource becomes less productive per individual demand as units work harder for less and less.

He demonstrates the usefulness of the SD technique for HE planning through highlighting its explanatory strengths, *i.e.* 'the hows' and the 'the whys' of system behaviour. However, he did not work with any key decision-makers at Queensland University. This is a significant limitation of his research, because the findings, though interesting, had little impact on the planning of the university. We contend it is important to work with stakeholders in order to identify the relevant problems, *i.e.* 'the whats', which need to be examined. Moreover, model ownership must be achieved through passing verification and validation tests to the satisfaction of the stakeholders.

$$\text{Verificati on} + \text{Validation} = \text{Model Confidence} \Rightarrow \text{Model Ownership} \Rightarrow \text{Meaningful Insights}$$

Hence, the insights from the SD model have meaning that may facilitate action. Clearly, there is a need for a soft methodology to complement the SD technique for the purpose of HE planning.

6. The Essence of Hard and Soft Systems Thinking

We contend that SD is a hard methodology that is associated with hard systems thinking, while soft methodologies are linked to soft systems thinking. It is important to highlight the essence of hard and soft systems thinking to justify the development of the Holon Planning and Costing Framework.

Hard Systems Thinking

Checkland (1981) considers systems engineering and RAND systems analysis as hard systems methodologies, because both are systematic in the sense that they proceed in a rational and well-ordered manner. Moreover, he highlights the essence of their approach to real-world problem solving.

> *"there is a desired state S_1, and a present state,S_0, and alternative ways of getting from S_0 to S_1. 'Problem solving', according to this view, consists of defining S_1 and S_0 and selecting the best means of reducing the difference between them."*
>
> (Checkland 1981)

He argues that the distinguishing characteristic of all hard systems thinking is the belief that real-world problems can be investigated in this way. We believe that most hard methodologies are goal-orientated and assume the problem, *i.e.* 'the what', is given for the goal state S_1, *e.g.* to build a product to meet certain requirements, the usual objective is find the best way of building the product to meet the requirements *i.e.* 'the how'.

Mathematical techniques such as regression analysis can investigate alternative ways to achieve state S_1.

We contend that SD can be applied to this type of real-world problem solving. Furthermore, a key feature of SD is its explanatory strength, whereby it can produce the best means, *i.e*. 'the how', to achieving S_1 and 'the why'. Therefore, we consider SD to be associated with hard systems thinking. We contend that the identification of the problem, *i.e*. 'the what' is a significant weakness of hard systems thinking, and argue that there is a need to combine SD with a soft methodology.

Soft Systems Thinking

When investigating social situations the problem, *i.e*. ' the what', cannot be assumed as a given. Stakeholders may have different views of what are the most important problems that must be solved in order to improve the situation. Soft methodologies began to emerge with the aim of attempting to assist in understanding the perspective of the stakeholder, which may lead to relevant improvements in the area of concern.

We believe some soft methodologies use systems as mental constructs to help the stakeholder/ facilitator make sense of a situation. Additionally, the frame of reference of the modeller changes from observer to facilitator in order to understand stakeholders' points of view. Most soft methodologies can be associated with soft systems thinking. Bell *et al* (1999a) argue that the main aim of the soft systems thinker is to identify state S_0 problems, *i.e*. 'the whats' relevant to that social situation which require solving or controlling, to produce a desired state S_1. A brief overview of SSM is undertaken because it is an important methodology and it has been argued that it should be combined SD (Lane and Oliva 1998).

7. Soft Systems Methodology (SSM)

SSM (Checkland 1981) emerged from systems engineering. It is a systems-based general learning methodology (see table 1) for investigating and improving a problem situation.

Stage	Stage Objective
1 and 2	Attempt to build the richest possible picture of the situation.
3	Aims to describe the nature of the chosen system.
4	Produces conceptual models of the defined system.
5	Compares conceptual model with actual situation in order to generated debate with the stakeholders.
6	Outline possible changes that are desirable and feasible.
7	Involves taking action based on stage 6.

Table 1: Key stages of SSM

DeMarco (1982) states that:

"*You cannot control what you cannot measure*"

(DeMarco, 1982)

Bell *et al* (1999a; 1999b) contend that the lack of use of metrics within SSM is a significant methodological limitation. Furthermore, they believe the identification of relevant problems and the metrication of them leads to more informed decision-making.

8. The Holon Methodology

Various Software Process Improvement (SPI) frameworks and methodologies assume all issues of software quality revolve around the development process (survey in Bell and Glijinis, 1997). Moreover, these SPI approaches are underpinned by representational measurement theory (Fenton 1991). A formal definition of measurement is:

> *"Measurement is the process by which numbers or symbols are assigned to attributes of entities in the real world in such a way as to characterise them according to clearly defined rules. The numerical assignment is called the measure."*
>
> (Fenton *et al* 1995)

Measurement is concerned with capturing information about attributes of entities. An entity can be an object, *e.g.* a product, or an event, *e.g.* a process. The attribute is the feature or property of the entity that is of interest, *e.g.* effort, is an attribute of a process.

Basili and Rombach (1988) believe software metrics programmes have failed because they have ill-defined objectives. To address this, Basili, with the collaboration of various researchers, developed a goal-orientated measurement approach called GQM. Bell *et al* (1999b) contend that GQM does not provide any guidelines or methods for identifying problems and goals as perceived by key stakeholders of a software project. They contend there is a need to augment GQM with a soft methodology that assists in identifying such stakeholder problems which may require metrication. Merging SSM and GQM gives a distinctive new soft approach – the Holon Methodology.

Checkland (1986) prefers to use the word "holon" rather than "system" for it highlights a distinctive approach to investigating a social situation. Checkland attributes the word holon to Koestler, who used it to express the principle of hierarchical structure. We consider a holon to be an abstract representation of a social situation that captures all problems. The methodology is used as a framework to discover relevant problems from a stakeholder point of view, which are organised in a layered structure. We use Ackoff's analysis of the systems thinking method to support this framework. We originally conceived the Holon Methodology as a *post-mortem* approach that improves the software development process through examining completed software projects. An outline of the key stages of the *post-mortem* approach is given.

Post-mortem Approach

The approach has four stages: Framing, Enquiry, Metrication and Action (see figure 2). A preliminary interview with the person who has initiated an interest in the Holon Methodology is undertaken in the framing stage. The enquiry stage aims to identify the problems as perceived by the stakeholders. The metrication stage attempts to resolve the identified problems to enable metrics to be collected through the use of the GQM methodology. In the Action Stage templates are used to collect the software metrics, which are stored in a website that is internal to the organisation. The data collected

increases the quantitative visibility of the situation and should facilitate stakeholder action. Bell *et al* (1999b) have undertaken a case study that used three stages of the methodology with an experienced software designer and developer.

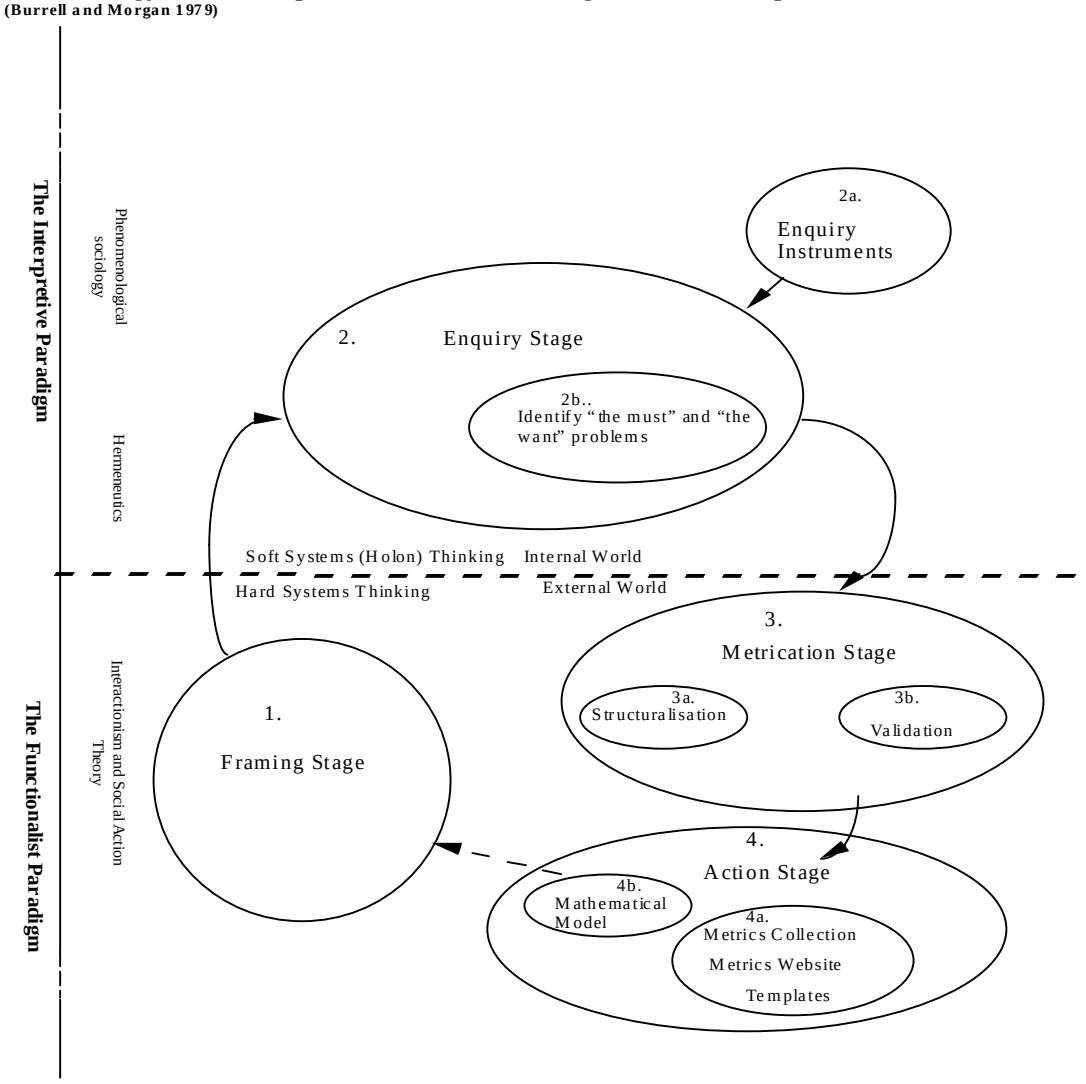

Figure 2: The Four Stage Model of the Holon Methodology (Bell et al *1999b)*

Soft Teleological Approach

The method used by Dearing (1997) to produce a vision for the HE system prompted the redesign of the Holon Methodology; we consider it to be a soft teleological approach. A range of senior academics, industrialists and politicians were invited to join the 'national committee of inquiry into higher education' chaired by Dearing. They investigated the problems, *i.e.* 'the whats', associated with the current state S_0 of the HE system and relevant environmental issues. The committee then constructed a vision of a desired state S_1 for the HE system to meet the needs of a 'learning society', and finally agreed recommendations, *i.e.* 'the hows', to achieve this vision.

Bell *et al* (1999a) believe the updated Holon Methodology, to be a 'soft teleological approach' (see figure 3) with six stages, but four essential parts. The first part aims to highlight the problems associated with the state of the current situation (S_0) as viewed by

the stakeholder. The second part identifies the most important problems to be solved in a vision of a future state (S_1). The third part lists the problems, *e.g.* no understanding of recruitment costs, and a number of goals are identified, *e.g.* to understand academic recruitment effort. Questions are developed to characterise each problem, *e.g.* how many hours of academic input are required for student recruitment, and the generated metrics are used to assess the problem. The fourth part involves improving the situation through informed systemic decision-making in order to achieve the vision. Bell *et al* (2000) discuss the redesigned methodology, and include a hypothetical case study investigating the admissions process, in order to highlight the strengths and weaknesses of the Holon Methodology.

Figure 3: Overview of the Key Parts of a Soft Teleological Approach

We believe the updated Holon Methodology has two significant strengths. Firstly, it assists in developing a desirable vision of a future state S_1. Secondly, a relevant metrics programme can be derived through the approach.

9. Holon Planning and Costing Framework

We contend that an informal SPI approach to controlling and improving HE systems is most appropriate, complementing a systemic view of planning. The underlying principle of the Holon Planning and Costing Framework is:

To identify an agreed future and to design ways of bringing it about within cost constraints

The Holon Planning and Costing Framework combines a soft methodology (Holon) and a hard technique (SD). The Holon Methodology addresses 'the who', 'the what', 'the where' and 'the when' type questions at the current state S_0, and generates a vision of a desired state S_1. Additionally, this produces a relevant metrics programme, and the collected metrics can be used as dynamic behaviour patterns. The explanatory capability of SD tackles 'the how' and 'the why' type questions. Table 2 illustrates the most important traits of this framework.

1	An holistic view of a situation.
2	The use of a soft methodology to enable the capture of the stakeholders' point of view.
3	Controlling the effects of bounded rationality.
4	The researchers' role as facilitator.
5	Development of a desirable and feasible vision.
6	Creation of a relevant metrics programme.
7	Emphasis on the SD model ownership problem.
8	Producing the 'best solution' to achieve the vision given the cost constraints.
9	The continuous use of an SD model for examining various 'what-if' scenarios.

Table 2: Key traits of the Holon Planning and Costing Framework (adapted from Bell *et al* 1999c).

The Holon Planning and Costing Framework is being applied within SCISM at South Bank University in an exploratory case study. A review of QAA and the RAE literature has assisted in the identification and labelling of the relevant holons, *i.e.* 'the where'. We have identified relevant academic and administrative staff, *i.e.* 'the who', participants in the planning process. Individual and group meetings have been held to identify the problems, *i.e.* 'the whats', associated with the current state S_0 of SCISM. This has led to the formulation of an agreed desired state S_1, *i.e.* the vision (see figure 3), and an appropriate metrics programme (Warwick *et al* 2000a).

We believe that to ensure model ownership various verification and validation tests must be applied throughout the planning process. Warwick *et al* (2000b) have produced a table of verifications and validations, which are selected depending on the objective of the meetings. Further consultations are scheduled in order to develop a SD model to the satisfaction of the stakeholders. In this way, the insights gained from the SD model will be meaningful to them, which should facilitate action to improve the situation and achieve the agreed desired vision. We consider this work as the initial part of a continuous planning and costing programme.

10. Conclusion

The Rudyard Kipling quotation (following the abstract) confirms our view that soft methodologies complement hard techniques, because they examine different types of questions. We believe the Holon Planning and Costing Framework addresses all the questions identified by Kipling. Furthermore, we contend that representational measurement theory (Fenton 1991) cements soft and hard systems thinking.

This alternative planning approach should assist in improving teaching and research quality given the cost constraints for it aims to empower the stakeholders. We believe the framework needs maturing through practice, in order to highlight its deficiencies. It is likely that the underpinning theory and its practice may be strengthened through broader

interdisciplinary research encompassing Psychology, Software Engineering, Servo-Mechanics Theory and Organisational Behaviour.

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