Using the Holon Framework: from Enquiry to Metrication – A Higher Education Case Study

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Abstract

This paper discusses the Holon Framework, which aims to improve and control processes within a School in a university in the United Kingdom. The developing framework has emerged from the Systems Movement and Software Engineering, combining aspects of Soft Systems Thinking and Hard Systems Thinking. We highlight the key characteristics of Higher Education Process Improvement and Control. An overview of the soft and hard part of the Holon Framework is provided. We justify the case study approach given the nature of the investigation. The soft part of the framework, which is linked to improvement, is employed to identify relevant problems and generate a baseline metrics programme. The research design of the case study is used to evaluate our findings. Finally, we outline future work in employing the hard part of the framework which is linked to control; this will complete the full cycle of research and further establish the Holon Framework.

"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)

Key Words: Holon Framework, Soft Systems Thinking, Hard Systems Thinking, Higher Education Process Improvement, Higher Education Process Control, Case Study Research Approach, System Dynamics.

1.0 Introduction

Universities in the United Kingdom (UK) are evolving to meet the teaching and research demands of various government organisations. The Quality Assurance Agency (QAA) examines university arrangements for managing the quality and standards of teaching and learning at subject level. The Research Assessment Exercise (RAE) examines research quality of universities, enabling public funding to be proportionally distributed. We are developing the Holon Framework to improve and control the teaching and research processes in a School within a university. Our approach aims to empower academics and administrators through resolving relevant problems, metricating them, generating a pragmatic vision and moving towards it. We believe the Holon Framework is complementary to the assessment exercises of the QAA and RAE.

The Holon Framework is an interdisciplinary approach derived from the systems movement and software engineering. The systems movement is concerned with the concepts of systemic wholeness and systematic analysis. Checkland (1981) identifies two fundamentally different ways of undertaking an inquiry in which systems ideas are applied. These are Hard

Systems Thinking (HST) and Soft Systems Thinking (SST). We discuss the essence of HST and identify a key weakness, which explains the development of SST and Soft methodologies, such as Soft Systems Methodology (SSM) (Checkland, 1981). A weakness of SSM is highlighted to justify the need to incorporate ideas from representational measurement theory (Fenton and Pfleeger, 1996).

The software industry is bedevilled by problems such as cost overruns, schedule slippage and poor product quality, which account for the emergence of the Software Engineering discipline. A fundamental area of research in software engineering is software project management; this may be subdivided into Software Process Improvement (SPI) and Software Process Control (SPC) research (Bell *et al,* 2000b). We contend the key aims of SPI and SPC can be applied to assist in the management of Higher Education (HE) institutions. Therefore, we introduce two fields of study: Higher Education Process Improvement (HEPI) and Higher Education Process Control (HEPC). HEPI research is underpinned by the view that all issues of HE quality revolve around improving processes. HEPC research is underwritten by the notion that a disciplined approach to education and research provision is needed in order to achieve sensible cost, timely delivery and quality targets. We describe the basic characteristics of HEPI and HEPC research and argue that they are inextricably linked through the use of metrics.

An overview of the Holon Framework is provided. This paper illustrates the soft part of the framework, which combines aspects of SSM and the Goal/Question/Metrics (GQM) methodology (Basili and Rombach, 1988). It is associated with improvement for it addresses certain types of questions *i.e.* 'the what', 'the where', and 'the who'. The hard part of the framework is linked with control for it addresses different questions, *i.e.* 'the how', 'the why', 'the when', and uses the System Dynamics (SD) (Forrester, 1961) technique. Representational measurement theory cements the soft and hard parts of the approach.

The soft part of the framework is applied to investigate a School within a UK university. The selection of the case study approach (Yin, 1984) is justified. However, we believe Yin's research design for conducting case studies is limited as it is specifically aimed at the social sciences and their methodologies. His research design is broadened to meet our requirements for a HE investigation. We describe the fundamental components of our case study design for the two hypotheses that are being tested. The aim of the case study reported here is to highlight the problems ('the whats'), which affect various processes ('the wheres') during the academic year, from the point of view of the academics and administrators ('the who'). The findings of the *visioning* study are outlined through exemplar narratives with the metrics that were generated to characterise certain problems. The metrics generated from the study are treated as a baseline measurement programme, which is utilised for controlling the processes within the School.

We evaluate the capabilities of the soft part of the Holon Framework, both internally and externally. The internal evaluation relies on academics and administrators to confirm the findings from the Holon approach. Additionally, we compare the results of our work with an internal report on the School undertaken by university higher management (Warwick *et al,* 2000a) and the university corporate plan. The external evaluation uses the QAA (2000) and RAE (1999) assessment templates, which examine the teaching and research quality of HE institutions. The case study findings are compared with the QAA and RAE assessment templates. Additionally, we highlight some emerging criticisms of the QAA and RAE

assessment approaches. We outline future research, utilising the SD technique to derive strategies that enable the agreed vision of the School to be achieved.

2.0 Systems Movement

The systems movement contends that system concepts can provide a source of explanations for many kinds of observed phenomena, which are beyond the reach of reductionist science (Checkland, 1981). Checkland identifies HST and SST as two fundamentally different ways of undertaking an inquiry in which systems ideas are applied.

2.1 Hard Systems Thinking

Checkland considers both systems engineering and RAND systems analysis as hard systems methodologies, because both are systematic in that they proceed in a rational and well-ordered manner. 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 contends that the distinguishing characteristic of all HST is the belief that real-world problems can be investigated in this way. It is argued that most hard methodologies are goal-centred or goal-orientated in that they assume the problem, *i.e.* 'the what', is given for the goal state S_1. For example, to build a product to meet certain requirements, the usual objective is to 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. It is assumed that there is clarity and no ambiguity in the definitions of S_1 and S_0. We contend that the identification of the problem, *i.e.* 'the what' is a significant weakness of HST, and agree with others (Lane and Oliva, 1998; Lehaney, Clark and Paul, 1999) that there is a need to combine mathematical techniques with a soft methodology.

2.2 Soft Systems Thinking

When investigating social situations, systems theorists realised that the problem, *i.e.* 'the what', could not be assumed as a given. Stakeholders may have different views of what are the most important problems to be solved in order to improve the situation. Over the last 20 years or so, soft methodologies have emerged with the aim of attempting to assist in understanding the perspective of the stakeholder, leading to relevant improvements in the area of concern. We argue that some soft methodologies use systems as mental constructs to help the stakeholder and the facilitator make sense of a situation. Note that 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 SST. 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 in a social situation, which require solving or controlling in order to produce a desired state S_1.

SSM (Checkland, 1981) emerged from systems engineering. It is a systems-based general learning methodology for investigating, learning about and improving a problem situation. There are many accounts of successful applications of SSM in a variety of organisations. We contend, however, that there are weaknesses in the method, and one of these concerns the way in which system change is controlled. DeMarco (1982) states that 'You cannot control
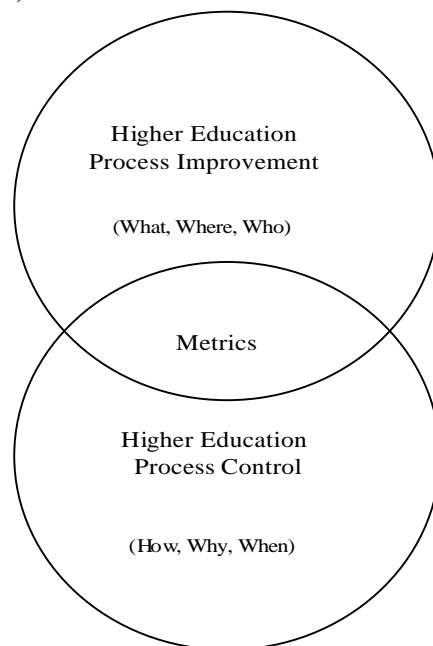
what you cannot measure'. Bell *et al* (1999a; 1999b) find that the lack of use of metrics within SSM is a significant methodological limitation. Furthermore, they explain that the identification of relevant problems and their metrication will lead to more informed decision-making.

3.0 Higher Education

We believe that the management of universities (Trow, 1994) could be enhanced through the use of new concepts and methodologies being developed in various related disciplines, *e.g.* Software Engineering. Bell *et al* (2001b) contend software project management can be divided into two research areas, SPC and SPI. Moreover, some of the problems addressed by SPI, *e.g.* poor documentation quality, and SPC, *e.g.* high staff turnover, can be found in HE institutions. Therefore, it is suggested that HE management should be divided into HEPI and HEPC. The fundamental aims of these two new topics of research are highlighted.

Process improvement research in HE is underpinned by the view that many issues of teaching and research quality revolve around improving processes. Additionally, it aims to enhance quantitative understanding through numerical representation of identified problems in order to improve change management decision-making. Process improvement focuses on 'characterising', *e.g.* establishing and enhancing metric baselines, and 'improving', *e.g.* removing process "bottlenecks", and is underwritten by representational measurement theory.

Process control research in HE is informed by the notion that a systemic approach is needed to achieve quality teaching and research targets, and to monitor the processes which impact on these, specifically in course delivery, resource management, *etc*. Our research is based around an academic year, *i.e.* semester one, semester two, and clearing. It involves: identifying academic milestones; deriving strategies to enable those milestones to be met; establishing a metrics collection and collation programme; monitoring differences between actual and estimated milestones; and explaining differences through the use of algorithmic models to feed back into the strategies. HEPI and HEPC are inextricably linked through the use of metrics (see figure 1.0).

Higher Education
Process Improvement

(What, Where, Who)

Metrics

Higher Education
Process Control

(How, Why, When)

Figure 1.0: Highlighting the link between higher education process improvement and control

The Holon Framework merges aspects of SSM and GQM methodology, which is associated with improvement. Furthermore, it integrates the use of the SD technique, which can be linked with control. Hence, we derive the conjecture *that the Holon Framework is the way ahead for HEPI and HEPC research.* To gain confidence in the emerging approach a study is undertaken using the soft part of the framework, which addresses 'the what, 'the where', and 'the who' type questions.

4.0 The Research Process

Galliers (1991) identifies two different routes to building, testing and extending theory. Moreover, he acknowledges alternative approaches are possible. We have constructed a model (see figure 2.0) of the overall research process, taking into account the fundamental aims of the Holon Framework, the methods and techniques used, and selection of research approach. The model shows how the research design of the case study is applied, and implicitly takes into account theory development. However, the basic aim of the model is to confirm, refine or refute our conjecture. Furthermore, it may highlight practical and theoretical weaknesses that need to be addressed in the future.
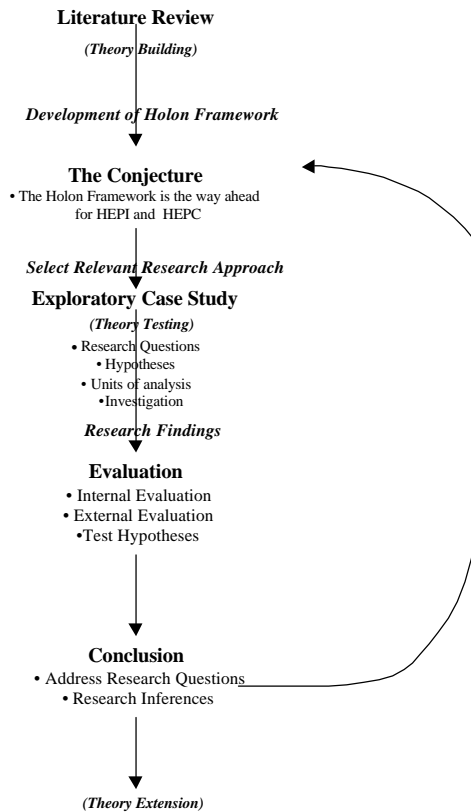
Literature Review

(Theory Building)

Development of Holon Framework

The Conjecture
• The Holon Framework is the way ahead
for HEPI and HEPC

Select Relevant Research Approach

Exploratory Case Study

(Theory Testing)

• Research Questions
• Hypotheses
• Units of analysis
•Investigation

Research Findings

Evaluation

• Internal Evaluation
• External Evaluation
•Test Hypotheses

Conclusion
• Address Research Questions
• Research Inferences

(Theory Extension)

Figure 2.0: Overview of research process

The understanding of research approaches in SD investigations is generally poor compared to more mature disciplines. We have reviewed literature from IS where there has been extensive discourse on this topic (Nissen *et al,* 1991; Galliers, 1991). Galliers (1991) has produced a taxonomy of approaches for IS research (see table 1.0) highlighting their strengths and weaknesses.

Scientific Approaches	Interpretivist Approaches
Laboratory Experiments	Subjective/Argumentative
Field Experiments	Reviews
Surveys	Action Research
Case Studies	Descriptive
Theorem Proof	
Forecasting	Futures Research
Simulation	Role / Game Playing

Table 1.0:   Identified approaches for IS research (Galliers, 1991).

He advocates the use of the word 'approach' rather than 'method', where an approach is 'a way of conducting research', which may embody a particular style and employ various methodologies, methods and techniques. He argues that no research approach has universal applicability. The taxonomy highlights situations in which an individual approach seems best suited to the research goal, the context of the investigation and the process of theory development and extension in the specific topic area.

The Holon Framework is viewed as an explanatory approach to improving and controlling human activity systems. We have produced arguments for the development of the framework and derived a conjecture for its use in HE management research. Additionally, Bell *et al* (forthcoming, 1999c) contend that the soft and hard parts of the framework can be linked to different social theories. It is argued that the soft part of the framework is linked either to Phenomenological Sociology (*Visioning mode*) or Hermeneutics (*Post-Mortem mode*), which are associated with the Interpretivist Paradigm (Burrell and Morgan, 1979). The generation of metrics and qualitative modelling, *e.g.* influence diagrams (Coyle, 1996), enables the link to the Functionalist Paradigm. It is argued that our style of SD modelling, which is associated with the hard part of the framework, is entwined with Interactionism and Social Action Theory.

After examining Galliers' work, we have chosen the case study approach. The important features, strengths and weaknesses of the case study approach are reproduced below (see table 2.0). Our fundamental reason for selecting the approach is that a case study enables an investigation to retain the holistic and meaningful characteristics of a real-world situation.

Approach	Key Feature	Strength	Weakness
Case Studies	An attempt at describing the relationships which exist in reality, usually within a single organisation or organisational group.	Capturing 'reality' in greater detail and analysing more variables.	Restriction to a single event/organisation. Difficulty in generalising, given problems of acquiring similar data from a statistically meaningful number of cases. Lack of control of variables. Different interrelations of events by individual researcher/stakeholders.

Table 2.0:   A summary of the case study approach (Galliers, 1991).

4.1 Case Study Research Design

Yin (1984) argues that there are many examples of sloppy case study investigations, and consequently, there have been numerous criticisms of the approach. He has attempted to introduce a more rigorous framework for conducting case study research, and finds that a good research design has five important components (see table 3.0).

Component Nº	Yin's Components	Proposed Components
1	A study's question	Research Question
2	Its proposition, if any	Proposition
3	Its unit(s) of analysis	Confirmation of Holons, problems, themes and metrics
4		Investigation
5	The logic linking the data to the proposition	Evaluation
6	The criteria for interpreting the findings	Interpretation of findings

Table 3.0:   Key components of the case study research design (adapted from Yin, 1984).

These components demand the development of a preliminary theory related to the topic of study. This is intended to improve the quality of the research design and become the main vehicle for generalising the results of the case study. However, to meet the requirements of our proposed case study a further component is introduced: Investigation (see table 3.0). We next outline each component of our design.

Component 1 – Research Question
The soft part of the Holon Framework attempts to examine a School within a university from the point of view of the stakeholders – academics and administrators. We have derived two research questions:
- *Does the soft part of the Holon Framework capture relevant problems associated with the School to the satisfaction of the stakeholders?*
- *Does the soft part of the Holon Framework identify metrics that could improve the quantitative visibility of the School?*

Component 2 – Proposition
The exploratory study has two research hypotheses. These are related to the problem and metrication identification capabilities of the Holon Framework.
- Hypothesis 1 – *The soft part of the Holon Framework highlights the relevant problems associated with the School.*
- Hypothesis 2 – *The soft part of the Holon Framework highlights metrics for the School that could have improved its quantitative visibility.*

Component 3 – Unit(s) of Analysis
The soft nature of the investigation influences the unit of analysis. We believe that the stakeholders must confirm the outputs, *e.g.* Holons, vision, problems, themes and metrics, from each stage of the framework before commencing with the next.

Component 4 – Investigation
We believe that this component must be an integral part of a research design. The study must be conducted in a logical manner enabling a hypothesis to be rigorously tested. The Holon Framework uses a model (see figure 3.0) to guide the intervention process. The soft part of the framework emphasises verification of the outputs which are expected on completion of each stage. This should assist in achieving stakeholder ownership of the SD model.

Component 5 – Evaluation
We intend to evaluate the findings of the soft part of the Holon Framework both internally and externally. The internal evaluation initially relies on stakeholders to confirm the findings from the Holon approach. Furthermore, we review the results of our work against an internal report on the School undertaken by university higher management. The external evaluation compares our findings with the teaching and research templates of the QAA and RAE.

Component 6 – Interpretation of Findings
The evaluation of the problem and metric identification capabilities of the Holon Framework will allow us to test the two hypotheses. Additionally, we will attempt to answer the research questions through interpreting the study findings. This may lead to confirmation, refinement or refutation of the conjecture.

5.0 The Holon Framework

Ackoff (1979) contends that managers are not confronted with problems that are independent of each other, but with a group of problems that are interrelated, dynamic and transient. He calls such complex situations ' messes'. In the 1940s the formulation of a new world view was brought about by a growing interest in systems, their growing complexity and the increasing difficulty of managing them effectively. This led to the realisation that systems are wholes, which lose their essential properties when taken apart. Consequently, wholes cannot be understood by analysis; this gave impetus to systems thinking. To investigate a complex situation, a three step systems thinking method is applied. Firstly, the system of concern is framed (see figure 7.0) and conceptualised as part of one or many larger wholes (see figure 6.0). Next, the larger containing systems that may influence this framed system are identified. Thirdly, the important subsystems within the framed system are revealed and through analysis their structure is obtained.

Checkland (1988) argues that researchers who apply systems concepts to investigate social situations face difficulties because these situations are never clearly defined. He prefers to use the word 'Holon' rather than 'system' as it highlights a distinctive approach to investigating such situations. Checkland notes that the word 'Holon' was originally coined by Koestler (1967) to express the principle of hierarchical structure. We consider a Holon to be an abstract representation of a social situation that captures all problems. It is used as a framework to discover relevant issues from stakeholders' points of view; these are organised in a layered structure. In accordance with SSM, they are used to enquire into the problem domain by facilitating open dialogue. The Holon Framework (see figure 3.0) can be used for either *post-mortem* or *visioning* investigations. The different stages of the Holon Framework are outlined and illustrated through the HE case study.
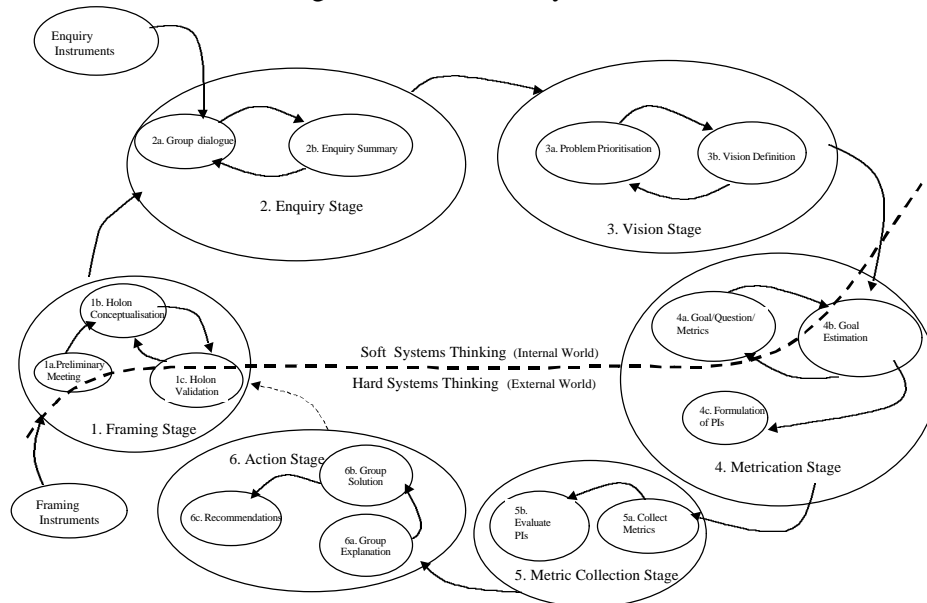

Figure 3.0: The Holon Framework (Bell *et al*, forthcoming; 2000b)

The *visioning mode* is selected for the HE investigation, and consists of four main parts (see Figure 4.0). The first part aims to highlight the problems, as viewed by the stakeholders, associated with the state of the current situation (S_0). The second part encompasses the most important themes (collection of related problems) to be solved in a vision of a future state (S_1). The third part lists the themes that need to be understood, and a number of goals are identified. Questions are developed to characterise each problem, and the generated metrics are used to assess the problem. The fourth part involves modelling the situation S_0 in order to improve it through informed systemic decision-making, to achieve the vision S_1.
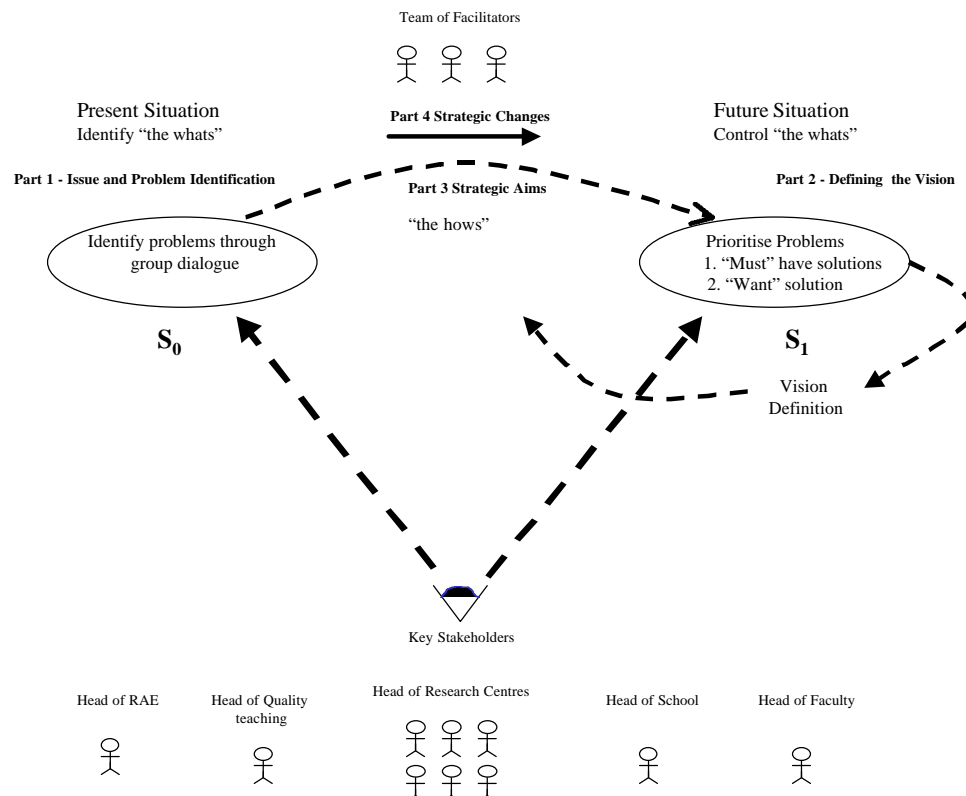

Figure 4.0: Overview of the key aspects of the visioning mode (Bell *et al*, forthcoming; 2000b)

5.1 The Framing Stage

This stage has a number of objectives, among which are that the stakeholders are identified and familiarised with the framework being used, that the Framing Holon and Environment Holon are identified and labelled (including sub-holons where necessary) and that the investigators gain a broad understanding of the problem situation. Outputs from this stage will be the identified stakeholders ('the who') and an agreed Holon structure that can be used to guide the investigation and any modelling that takes place.

We next illustrate the Framing Stage through the HE Case Study. During the first meeting with the Head of School, we discussed the Holon Framework and agreed the issue to be addressed. A review of the QAA and RAE literature assisted in the initial identification and labelling of the relevant Holons, *i.e.* 'the where'. Relevant academic and administrative staff, *i.e.* 'the who', were identified as participants for the HE case study.

The School is organised so that all courses fall into one of three main programmes of study: the Business Information Technology Programme, the Computing Programme (primarily

Undergraduate) and the Postgraduate Programme. The Business Information Technology and Computing Programmes contain all undergraduate full-time and part-time courses. The Postgraduate Programme contains all postgraduate courses, and is further divided into specialist and conversion courses. The Business Information Technology and Computing Programmes each have a Programme Director, and the Postgraduate Programme has two directors, one for each of the specialist and conversion courses (see figure 5.0).

Academic Staff are clustered into Divisions based on subject areas, with each Division regulating the quality of course units within its subject area. Research-active staff are usually associated with research centres which form the focus for the School's research activity. Two further stakeholders were identified in the Director of Quality, and the Director of Research. Added to these were the School's Administrative Officer and the Director of Staff Development. An external focus was provided by the Dean of Faculty, while the Head of School provided an overview of all the School's activities and external links within the University and with industry. The complete list of stakeholders is shown in Figure 5.0:
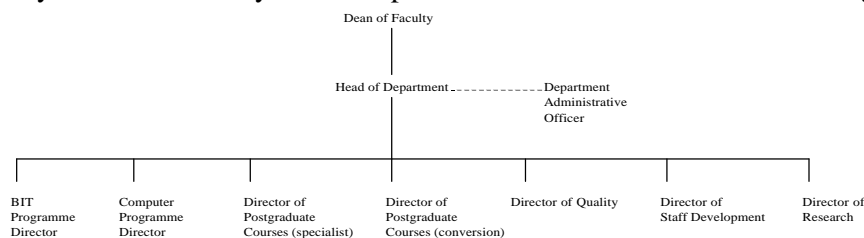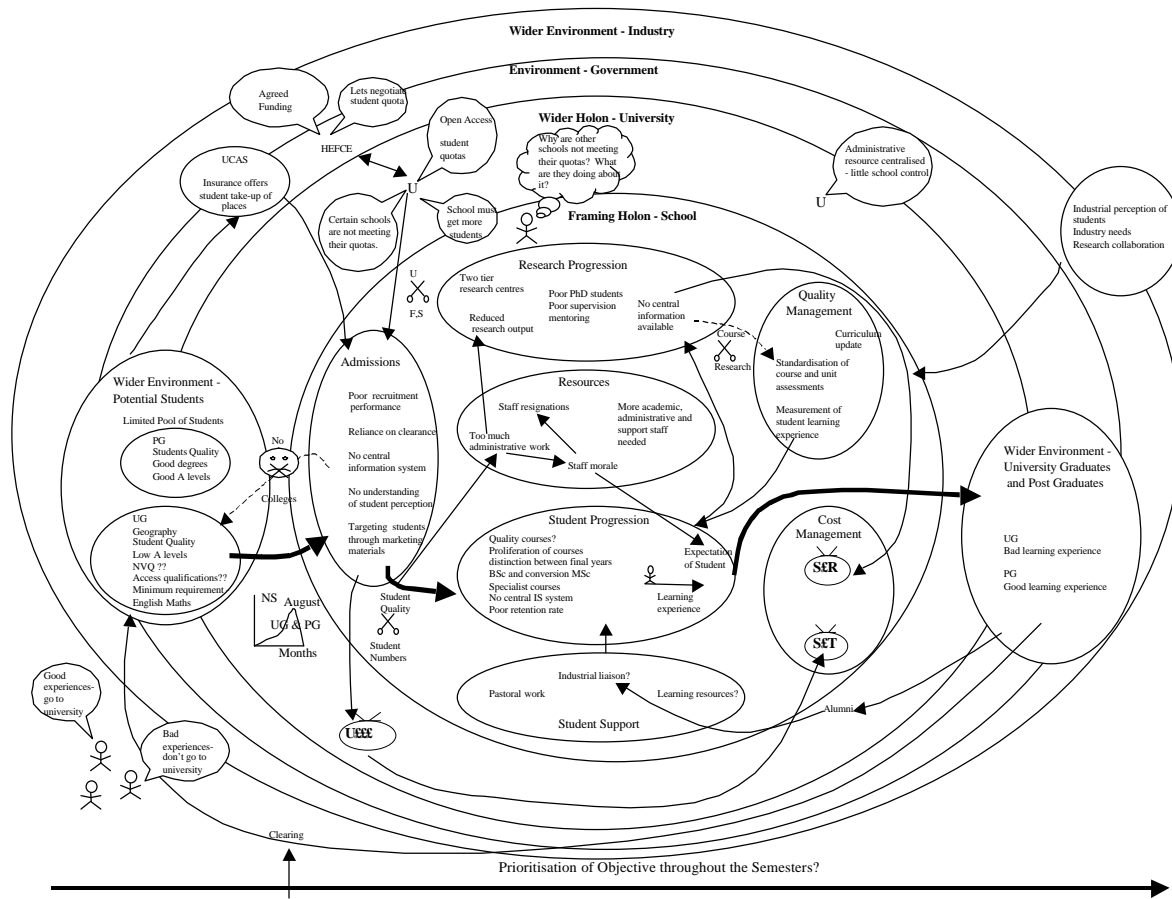

Figure 5.0: List of stakeholders, *i.e.* 'the who', participating in the study (Warwick *et al,* 2000b)

Individual meetings were held to gain an understanding of the situation from the perspective of each stakeholder, and to ensure the conceptual model represented the situation. Moreover, these preliminary meetings enabled the researchers to initially identify problems, *i.e.* 'the whats', associated with the School, which would assist the enquiry stage.

5.2 The Enquiry Stage

This stage aims to identify the problems as perceived by the stakeholders. The agreed conceptual model of the School provides a focus for dialogue. During group meetings with the stakeholders, information is placed in the relevant holons through the use of rich pictures and written notes. The outputs of this stage are rich pictures and narratives for each sub-holon highlighting the problems (or the mess) associated with the situation of concern; these are verified by the stakeholders.

We next illustrate the Enquiry Stage through the HE Case Study. The enquiry stage comprised an informally structured group meeting to explore the perceptions of the academics and administrators in order to identify and confirm the problems that characterise the School. A large sheet of paper with the Holons sketched on it was used to capture all of the relevant problems in the wider environment (see figure 6.0).

Rich Picture diagram labels (Figure 6.0):

Wider Environment - Industry
Environment - Government
Wider Holon - University
Framing Holon - School

Agreed Funding
Lets negotiate student quota
Open Access student quotas
Why are other schools not meeting their quotas? What are they doing about it?
Administrative resource centralised - little school control
UCAS — Insurance offers student take-up of places
HEFCE
Certain schools are not meeting their quotas.
School must get more students
Industrial perception of students, Industry needs, Research collaboration

Research Progression
Two tier research centres
Poor PhD students, Poor supervision mentoring
No central information available
Reduced research output
Quality Management
Curriculum update
Standardisation of course and unit assessments
Measurement of student learning experience
Course / Research

Admissions
Poor recruitment performance
Reliance on clearance
No central information system
No understanding of student perception
Targeting students through marketing materials

Wider Environment - Potential Students
Limited Pool of Students
PG: Students Quality, Good degrees, Good A levels
UG: Geography Student Quality, Low A levels, NVQ ??, Access qualifications??, Minimum requirement English Maths

Colleges
Resources
Staff resignations
Too much administrative work
More academic, administrative and support staff needed
Staff morale

Student Progression
Quality courses?
Proliferation of courses distinction between final years
BSc and conversion MSc
Specialist courses
No central IS system
Poor retention rate

Cost Management
Expectation of Student
Learning experience

Wider Environment - University Graduates and Post Graduates
UG: Bad learning experience
PG: Good learning experience

Student Support
Pastoral work
Industrial liaison?
Learning resources?
Alumni

Student Quality
Student Numbers
NS August UG & PG Months

Good experiences- go to university
Bad experiences- don't go to university

Clearing
Prioritisation of Objective throughout the Semesters?

Rich Picture Dictionary

Symbol	Meaning
(academic symbol)	Academic
(scissors)	Conflict
(face)	Low moral
(face)	Poor communication
PG (figure)	Postgraduate student
S£R	School research funding
S£T	School teaching funding
U	University
U£££	University funding
UCAS	University Central Admissions System
US (figure)	Undergraduate student

Figure 6.0: Summary of the HE (Wider Environment Holon) rich picture (Warwick *et al*, 2000b)

The findings from the enquiry stage are now detailed at the level of the Wider Holon – the University. The University is committed to a policy of 'Open Access', due partly to the socio-economic mix of potential students within its catchment area, and partly to the need to widen the pool of potential students in an effort to maintain student numbers. The University target for students is set with the Higher Education Funding Council for England (HEFCE) and individual School targets are negotiated taking into account the University target, Faculty targets and likely retention rates. It is vitally important that Schools meet their targets as this directly affects future resourcing in terms of staffing and finances allocated to the School.

In terms of students, there seems to be little contact made with those who have completed courses within the School, even though these are seen as potentially useful to the department in terms of industrial contacts, research activity and general recommendation of the School's courses. Indeed, while there is evidence to suggest that word-of-mouth recommendation is the primary attractor of postgraduate students to the courses, there is no formal process of external contact and liaison. At undergraduate level, there is less evidence of such recommendation for individual courses. Direct contact with potential undergraduate students is limited to Open Days organised by the University and the School, some visits to schools and colleges, some interviewing of individuals, and some University-wide initiatives (*e.g.* Widening Participation). Again, this process is not formalised at School level and no information is held by the School as to the numbers of students admitted from local schools and colleges. These observations clearly will impact on the Admissions Holon.

The University in general places great emphasis on the clearing period for filling its courses. The majority of students are recruited to the University during this period and this, coupled with the speed with which students need to be "signed up" (both to finalise numbers and also fend off competitor Universities) can have a negative effect on the quality of students recruited. The pressure to meet targets sometimes encourages staff to accept students who might seem, at first glance, to be under qualified or who perhaps over-estimate their own abilities. This clearly effects student progression and student support if they are enrolled.

The School has links with industry through its industrial placement process, its research activity and programme of course development. Industrial Liaison was felt to be adequate to the extent that links existed, but perhaps better use should be made of such links in terms of generating and supervising research, industrial placements and in attracting professionals to part-time and short courses.

Moving to a more detailed level in the Framing Holon (see figure 7.0), a number of significant problems were identified within the Admissions Holon, which significantly affect the School. The University applies pressure on the School to increase the targets of popular courses and is reluctant to reduce the targets for courses that fail to recruit. The School is increasing in size each year (in terms of FTEs) and the growth is becoming difficult to sustain (but targets must be met). Prior to clearing, undergraduate recruitment activity seems to result in relatively few 'firm acceptances' that convert into students. Many students will use the University as an insurance offer. This leads to all undergraduate courses within the School having to rely on clearing to meet targets. There is a worry that during clearing a certain amount of control is lost over recruitment with no time to give each application the scrutiny it deserves.

These pressures make it difficult to operate an effective and precise admissions process that weeds out academically unsuitable applicants. This is particularly acute at postgraduate level now that postgraduate admissions run as part of clearing from August onwards. During clearing, admissions decisions are made by volunteer academic staff who may have little or no experience of admissions requirements other than the basic criteria. Students apply from a variety of backgrounds and with a variety of qualifications so that it is unrealistic to expect anyone without substantial experience to be familiar with the majority of qualifications met. Admitting unsuitable students to courses, for whatever reason, will increase the pressure on student support resources, decrease course quality, increase the burden on academics and, probably, resulting in higher student withdrawals and subsequently additional students to find next year. Student turnover within the School is high with a large proportion of students

being new to the School at the start of the academic year. Withdrawal rates on some courses are high and need to be reduced, although some argue that high withdrawal rates are a necessary consequence of an 'Open Access' policy.

Marketing materials produced by the School would seem to be good although the wider question of course marketing in general should be reviewed. It is not clear that students always have appropriate expectations on commencing studies on one of the School's courses (in general terms or in terms of course content) and there are concerns that it does not target courses (particularly foundation and postgraduate courses) at a particular profile of student. Clearly, discontinuities between the School's expectations of students and their own expectations may result in a change of expectation either way, but may lead to student withdrawal or transfer request.
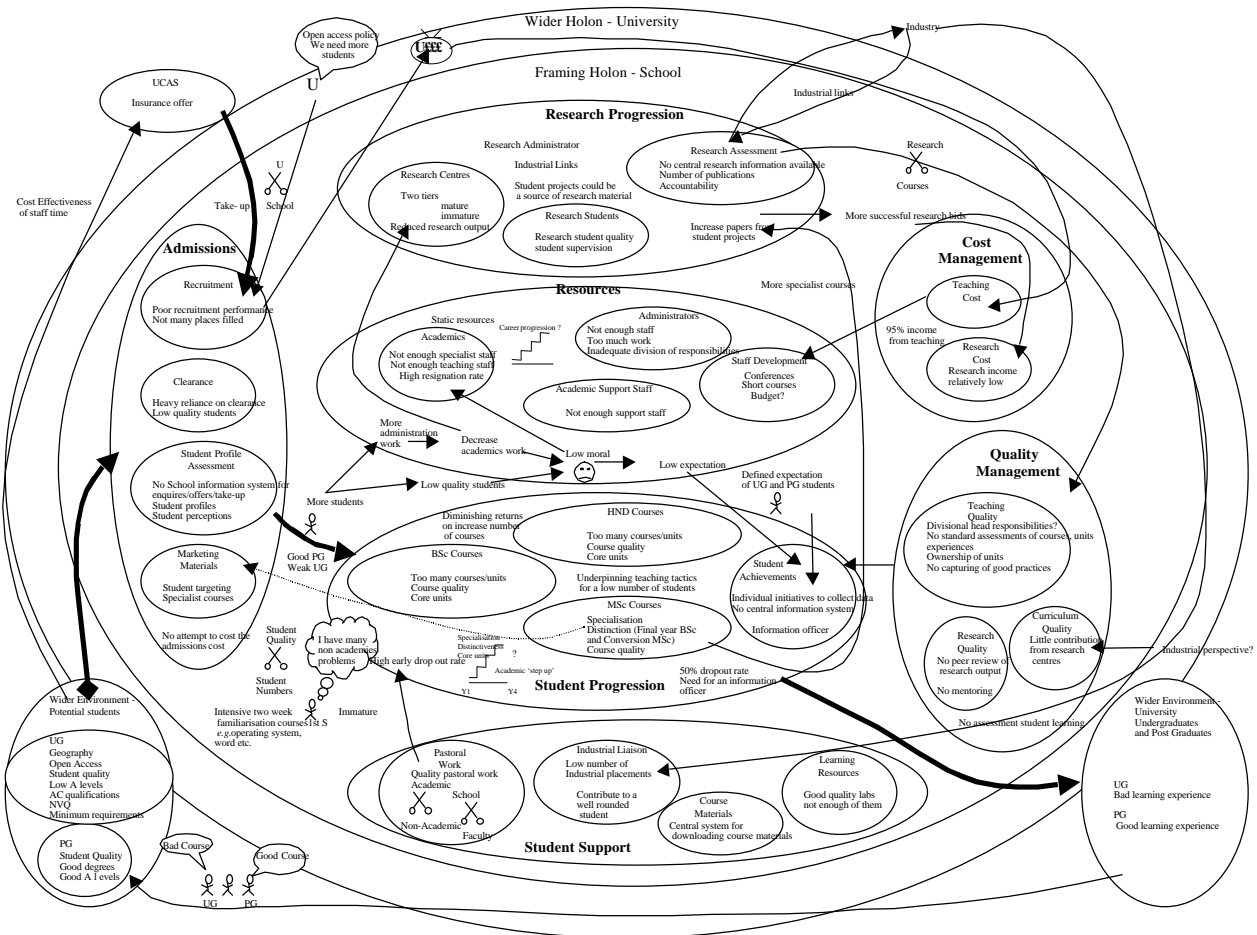
Figure 7.0: Summary of the HE (Framing and Sub-Holons) rich picture (Warwick *et al*, 2000b)

5.3 The Visioning Stage

This stage attempts to produce a vision for the situation of concern through solving some themes. Themes are a collection of related problems, which can be linked at the sub-holon hierarchical level. The stakeholders are asked to decide whether a theme is 'a must' or 'a want', *i.e.* a theme that must be solved or one which they would like to solve. The *vision mode* of the framework generates an attainable vision (based on Checkand's root definition) which attempts to solve or control certain themes within the foreseeable future, *i.e.* two to

three years. The outputs of this stage are identification of the themes and construction of an agreed vision for the situation of concern.

We next illustrate the Visioning Stage through the HE Case Study. We examined the information from the conceptual model and collated various related problems, which produced themes that could be linked to the sub-holon hierarchical level. Table 4.0 highlights related admission problems used to generate theme two – concerns about entry standards and numbers. A third meeting was arranged to confirm the themes with the academics and identify potential solutions. It was found that some of the solutions to the themes require structural changes to the School process, *e.g.* construction of an information system, and others require metrication, *e.g.* monitor student recruitment offers.

Project: HE case study	**Environmental Holon**: University	**Framing Holon:** School		**Sub-Holon:** Admissions
Problem Number	**Problems**	**Who**	**Must/ Want**	**Solution**
1	Poor entry qualifications of students entering our courses via clearing	Academic staff	M	Develop a metrics programme to understand the problem. Define minimum entry qualifications to undertake the appropriate course. Develop an Admissions data collection tool.
2	Reservations about targets for new students to be met at the start of each academic year	Programme directors and course directors	M	Develop a metrics programme to understand the problem.
4	High proportion of students recruited through clearing	Programme directors and course directors	W	Develop a metrics programme to understand the problem.
5	Provision worries of academic resources for the clearing process	Academic staff	W	Determine cost/benefit of clearing and possible reward strategies. Develop an Admissions data collection tool.

Table 4.0:   Some problems associated with the Admissions Sub-Holon (Bell *et al,* 2001a)

A vision for the School was articulated by the stakeholders using the elements of CATWOE (C - Customer(s), A - Actor(s), T- Transformation process, W – Weltanschauung, O – Owner(s), E - Environmental constraints) (Checkland, 1981). He uses this mnemonic to develop a root definition, which is generally a description of the current state S_0 of the situation. We utilise CATWOE to generate a vision definition, which is a description of a future state S_1 of the School. In order to achieve the vision the identified themes must be addressed over the next three years. The vision definition for the School is:

> *"The School has a good reputation within the university and local community. There is a close liaison with local schools to ensure students have acquired the appropriate skills to complete a Higher Education computing and mathematics course. Students who undertake a School course achieve their academic expectation whatever the background circumstances which in the long term benefits the community. The quality and quantity of the research output from the School attracts both industrial and government grants. This generates a reasonable balance*

between teaching and research funding which is reflected in the effort loading of the academic staff. Course units are annually updated through the integration of publications produced by the different research centres."

(Bell *et al,* 2001a)

5.4 The Metrication Stage

This stage analyses the themes and links the emergent problems with the appropriate hierarchical level. The GQM methodology is used to generate metrics that characterise the problems. The outputs of this stage are diagrams that highlight the hierarchical level of the problem and appropriate goal. Additionally, metrics tables are generated which highlight the theme ('what'), the appropriate Holon ('where') the metrics should be collected, and the relevant stakeholders ('who'). Additionally, the stakeholders are asked to make estimates of the current state S_0 and future state S_1 for each metric.

We next illustrate the Metrication Stage through HE Case Study. We analysed all of the identified themes in order to generate a basic metrics programme. Figure 8.0 shows both Recruitment (from October to July) and Clearing (Mid-August to September) offers should be collected. Further inspection of recruitment offers indicates individual courses must monitor student offers (see figure 9.0).
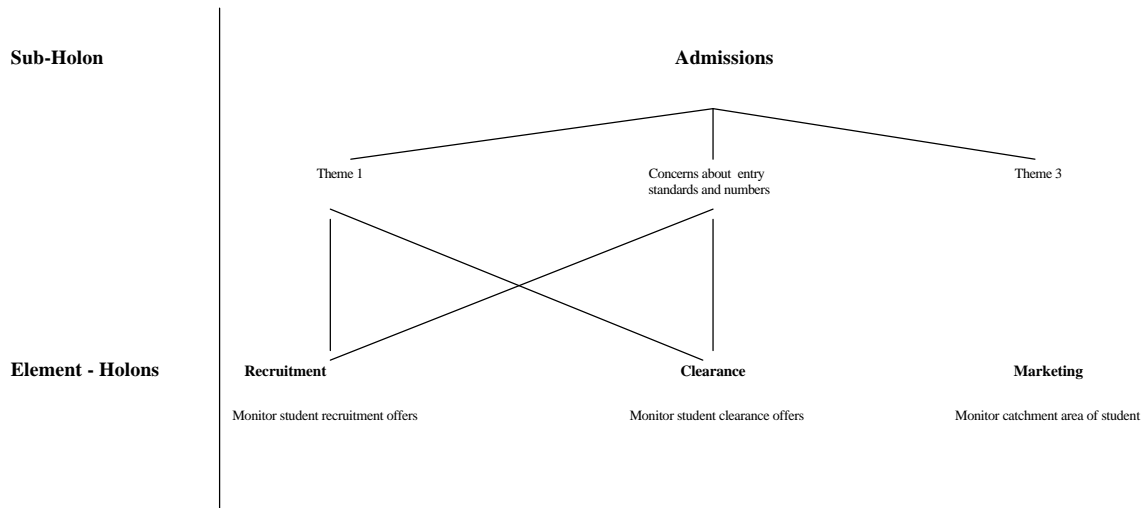

Figure 8.0: Analysis of theme 2 – Concerns about entry standards and numbers (Bell *et al,* 2001a)
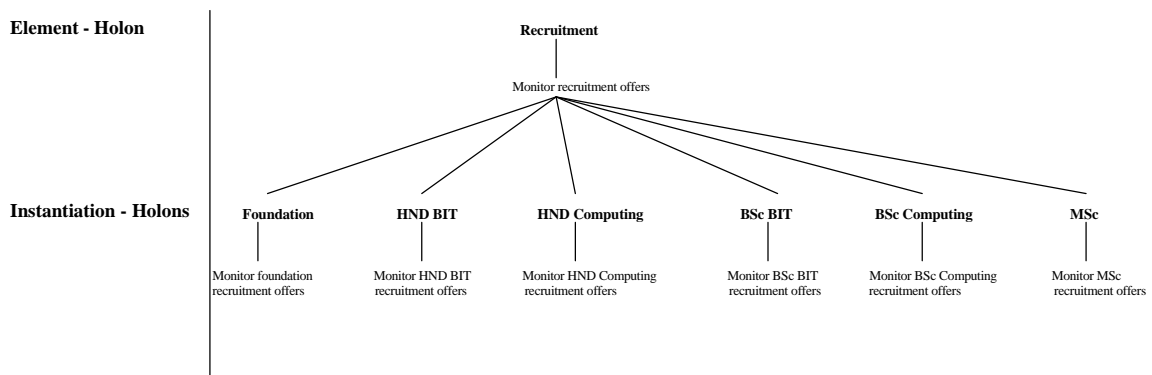

Figure 9.0: Analysis of the operation – monitor recruitment Offers (Bell *et al,* 2001a)

We have produced a number of metric tables to improve the quantitative visibility of the School. Moreover, the direct metrics are integrated into the Holon Metrics Tool.

Project: HE case study		**Where**: Admissions/ Recruitment/ BSc Computing							**Who**: Director of computing						
What: (Theme)	Concerns about entry standards and numbers														
Sub-operation:	Monitor BSc Computing recruitment offers														
Question:	How many BSc Computing students are enrolled via recruitment?														
Metric	Number of BSc Computing students enrolled via recruitment														
Dimension	Students/week														
Semester 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
N^o of accepted offers															
Comments															

Table 5.0:   **Example of a metrics table (Bell *et al*, 2001a)**

5.5 Metrics Collection Stage

This stage aims to collect software metrics over a period of time through the use of the Holon Metrics Tool, which is a web-based information system. Meetings are held regularly to enable the stakeholders to explain the dynamic behaviour patterns of the metrics, and to assess whether or not the School is achieving its vision. The outputs from this stage will help refine the Holon Metrics Tool, and complete one cycle of the data collection process.

The Holon Metrics Tool is fundamental to the Metrics Collection Stage. The tool has three important functions: Case Study, Metrics Collection and Metrics Collation. The first function provides an overview of the case study highlighting the problems, themes and vision for the School. The second function collects direct metrics from the relevant stakeholders. The third collates the direct and indirect metrics, which are used to produce cumulative and dynamic graphs. The Holon Metrics Tool will be used to present the current situation in two-monthly meetings. The aim is to assess the present position of the School with respect to the agreed vision through comparing actual data with S_0 and S_1 estimates. Furthermore, any current difficulties which might prevent the vision being achieved are highlighted and strategies to solve them are suggested.

5.6 The Action Stage

This stage (future work for the HE case study) aims to use the collected data to develop a SD model that explains the situation of concern, and which is owned by the stakeholders. Model ownership is achieved as agreed verification and validation tests are passed to the satisfaction of the stakeholders. The SD model will enable the development of meaningful strategies to achieve the agreed vision through examination of various 'what if' scenarios. The outputs of this stage are the construction of a SD model to the satisfaction of the stakeholder and the development of strategies to achieve the agreed vision.

6.0 Case Study Evaluation

The soft part of the Holon Framework was internally and externally evaluated in order to test the hypotheses. The internal evaluation requires the outputs from the different stages of the framework, *i.e.* from framing to metrication, to be used as the units of analysis, which must be approved by the stakeholders. The Holons ('the where') generated at the framing stage and the problems ('the whats') identified by the academics and administrators ('the who')

were accepted. Additionally, the metrics produced from the themes were verified to the satisfaction of the stakeholders.

The results of the HE case study (Warwick *et al,* 2000b) were compared with an internal review of the School. The School review was conducted by a panel, which included academic staff from other faculties within the university. To highlight the findings of the review panel the holon structure for the HE case study (see figure 7.0) was applied. Warwick *et al* (2000a) shows that there were broad areas of agreement between HE case study and the School review document. However, the Holon diagram for the former study was more densely populated with rich pictures and notes indicating more information was gained by the researchers. Additionally, some of the Holons were not covered in the review , which suggests the review was not as structured or comprehensive as it could have been. Finally, Warwick *et al* contend the School review highlights problems of concern, but gives no indication of how they are to be addressed, by whom, and what impact they have on other School activities.

The external evaluation is a comparison of the HE case study findings with the QAA (2000) and RAE (1999) assessment approaches. The QAA examines different processes that regulate the quality and standards of HE institutions. The QAA has developed an *aide-memoire* for subject review, which provides questions and prompts about Aims and Outcomes, Curricula, Assessment, Enhancement, Teaching and Learning, Student Progression, and Learning Resources.

The areas of concern identified by the *aide-memoire* were mapped on to the Holon structure (see figure 7.0). Furthermore, we compared the HE case study findings with the aims of the *aide-memoire.* We found that it focused on the following sub-holons: Quality Management (*e.g.* design and content of the curricula); Student Progression (*e.g.* academic guidance, feedback and supervisor arrangements); Student Support (*e.g.* effective number of learning resources for delivery of curricula); Resource (*e.g.* appropriate technical and administrative support). We believe the HE case study captures many of the problems that are examined by the QAA. However, it was noticeable that the *aide-memoire* does not significantly investigate the Admissions and Research Progression problems.

The RAE produces research quality ratings for every UK University department. These Ratings are used by external HE funding bodies to determine the main research grants. The research outputs, *e.g.* journal papers, and research processes, *e.g.* number of PhD students completing each year, are peered-reviewed through the RAE template. The template is used by universities to guide their submissions and consists of six parts: Overall Staff Summary (RA0); Research Active Individuals Details (RA1); Research Output (RA2); Research Students (RA3a); Research Studentships (RA3b); External Research Income (RA4); Textual Description (RA5); General Observations and Additional Information (RA6).

The areas of interest identified by the RAE template were again mapped onto the Holon structure. Moreover, we compared the HE case study findings with the objectives of the template. We discovered that the latter concentrates on the following sub-holons: Resource (*e.g.* summary information on all academics); Research Progression (*e.g.* information about the environment, structure, policies and strategies within which research is undertaken); Quality Management (*e.g.* research outputs). We believe the HE case study identifies many of the problems that are reviewed by the RAE. However, it was shown that the RAE template does not examine Admissions, Student Progression and Student Support problems.

We believe the evaluation of the soft part of the Holon Framework supports the two hypotheses. Furthermore, we have identified some emerging problems linked with the QAA and RAE assessment approach.

7.0 Emerging Criticisms of the QAA and RAE

The QAA and RAE respectively examine teaching quality and standards, and research quality of UK universities. These organisations work independently. Galbraith (1998a; 1998b) highlights several limitations with the dominant HE planning approach to justify the use of SD technique. Most importantly, the strategic aims are treated separately, and related goals are individually assessed through performance indictors (PIs), *e.g*. a goal to increase research output may be expressed as numbers of papers over 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.

We contend that if a school concentrates on either teaching quality or research quality depending on the relevant assessment life-cycle, then dysfunctional behaviour could 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. We contend that the RAE and QAA may generate unintended dysfunctional behaviour, particularly within new universities. For example, to ensure a high quality rating is attained these new universities may recruit research active lecturers from older HE institutions. These new members of staff are likely to demand high salaries and reduced teaching loads causing low morale amongst the established academics, and potentially creating more teaching hours for others within the recruiting department. Additionally, we believe the RAE and QAA templates do not explicitly examine the integration of journal papers into teaching units, the development of undergraduates into potential research students and departmental peer review process of research outputs.

The principle of bounded rationality was formulated by Herbert Simon (1979; 1976) as the basis for understanding human behaviour in complex systems. However, Ackoff (1979) argues that effective management of messes requires a systemic approach. We believe a holistic approach is needed to improve and control HE institutions integrating both the teaching and research activities.

8.0 Conclusions

An outline of the soft and hard parts of the Holon Framework has been given. We have shown that both SST and HST influence the development of the approach. Additionally, HEPI and HEPC have been introduced along with their respective characteristics, which could enhance the management of universities. The Kipling quotation at the start of the paper confirms the view that soft methodologies complement hard techniques. The Holon Framework tackles all the questions identified by Kipling. Soft methodologies address 'the what', 'the where', and 'the who' type questions, which can be related to the process improvement issue. Hard techniques tackle 'the how', 'the why' and 'the when' type questions, which can be linked to the process control issue. Representational measurement theory cements these approaches. The soft part of the framework investigates a School within a UK university. The strengths and weaknesses of the approach are shown through the case study. The study addresses two key research questions.

Does the soft part of the Holon Framework capture relevant problems associated with the School to the satisfaction of the stakeholders? We believe the soft part of the framework highlights the relevant problems associated with the School. Furthermore, the units of analysis*, i.e.* the outputs, used for evaluation increased academic and administrator confidence in the framework. A strength of this systemic approach (underpinned by systems thinking) is that it can produce a more comprehensive review than a systematic approach (underpinned by analytic thinking) as used by internal (university panel) and external (QAA and RAE assessment template) reviews. A weakness of the approach is that we assume the academics and administrators are objective about the current situation and not embroiled in political skulduggery. However, this concern may be reduced because of higher management support for the work.

Does the soft part of the Holon Framework identify metrics that could improve the quantitative visibility of the School ? We believe the identified metrics derived from relevant themes will increase the control of processes within the School. Moreover, the academics and administrators find the metrics tables to be useful as they themselves identified the problems, the metrics that should be collected, and the key stakeholders or users. Moreover, the Holon approach empowers stakeholders, because they identified the problems (at state S_0) which need controlling. We contend that the case study confirms our conjecture and justifies further research.

The collection of metrics enables the SD technique to be applied, which is the hard part of the Holon Framework. However, before collecting these data, influence diagrams (Coyle, 1996) are used to check the dimensional coherence of the metrics and highlight feedback loops operating between the Holons. We view this work as the initial structuralisation. The development of the Holon Metrics Tool brought out a potential weakness of the framework. A significant number of questions and metrics were allocated to programme directors because of their responsibilities. However, many of these questions and metrics should clearly be delegated to the relevant course directors. Moreover, the data to be collected will enhance their decision-making. Clearly, it is important to identify and work closely with all relevant stakeholders or meaningless and inaccurate SD models can be constructed. An important principle of the Holon Framework is *'to be value-full rather than value-free'*. The identification and confirmation of the problems by the relevant stakeholders should assist in achieving SD model ownership and accurate predications of future states. This important research finding generated the question – *Do SD practitioners identify relevant stakeholders?*

It is argued that HE management should concentrate on improving and controlling processes through systemic approaches, incorporating both teaching and research quality activities. We believe the Holon Framework would fit this requirement. Moreover, the QAA and RAE could select from the information collected to assist with their respective assessments. Such a systemic approach would highlight the potential for dysfunctional behaviour in new government initiatives. In this way the Holon Framework could complement the work of the QAA and RAE. Finally, we contend that the research process model (see figure 2.0) and units of analysis from the HE case study could be used to establish commonality between investigations. Here, the two objectives of General Systems Theory (Boulding, 1956) guide our research: first, to identify common Holons and problems which may constitute system dynamics archetype structures operating in different processes; and second, to base the maturing interdisciplinary framework on a spectrum of theories.

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