The Application of Conjoint Measurement to Reveal the Real Value of Research: A Case Study of an Australian University

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ABSTRACT

The measurement of the value of research is contentious in most companies. In universities where research is a fundamental part of their raison d'être it has much more importance. Here, not only does it affect national standing and the ability to attract the best staff and students, it also affects funding. This paper presents the results of a case study in which an advanced conjoint measurement system was assessed to determine whether it could give a comprehensive, transparent and agreeable assessment of a university's research value as seen the stakeholders who sponsor research there. 29 stakeholders took part in the study and the study presents aggregated results from these stakeholders. The ease with which this is done and the scope and utility of the output shows that the Conjoint Value Hierarchy (CVH) can be used as an auditable, reliable, transparent and usable measurement system that does not place excessive burdens on the university user.

KEYWORDS

Measurement, Research, Value, Management

I. INTRODUCTION

Most of us are familiar with Garvin's statement that "if you can't measure it, you can't manage it" [Garvin, 1993]. This tends to act as a powerful incentive to managers to try to measure what they need to measure. Over the last twenty years, universities worldwide have lost a degree of their academic independence with governments requiring outcomes of economic benefit to the country in proportion to the investment of funds. While teaching is a key part of a university's activities, and as described by Gunasekara in Australia [Gunasekara, 2004], has also been an area of great change it is the field of research that has drawn most attention.

One of the most interesting features of university performance measures is that, apart from being retrospective, they are based on simple output measures. While many Governments seek outcome measures compared to (financial) input measures, outcomes, usually expressed in terms of economic benefit require third parties to take up outputs and generate the outcomes. While it might be argued that Governments expect too much from their metrics it might also be argued that what they get is less than they could have. Simple performance measures such as citation rate, international conferences attended or performance measures of research quality lack the businessman's "so what". They fall short in that the give performance but not value; they do not say whether achieving high performance in some areas is worth the effort.

This paper describes a new approach to the measurement of research value and presents the results of a study undertaken in Australia in 2005. While of immediate relevance to the academic community, it is of wider interest. Any company or other organisation which funds or undertakes research will have asked at some time whether they give or receive value for money. There are several existing schemes in use by Western countries to assess university research, mostly with the aim or guiding the distribution of research funds. For reviews see [Geuna, Hidayat and Martin, 1999 and Millar, Senker, 2000 and

Von Tunzelmann, Mbula, 2001]. While some appear to be better than others and have consequently become templates for the development of other assessment schemes, none of them appear to have achieved widespread acceptance as fair and open schemes. This is particularly apparent when the research is more applied in nature, that is, when it is aimed at discovering the solution to more immediate problems rather than when it is aimed at just discovering.

II. BACKGROUND

The history and development of Australian Universities has been reviewed extensively in recent years. Authors such as a Milne [Milne, 2001] charted changes with a critical perspective born from a desire that his country, Canada, should not follow the path taken by Australia.

The Institution Assessment Framework (IAF) [see DEST, 2006 [1]] recently introduced in Australia is undoubtedly a significant advance over the previous Educational Profiles process and is a university assessment methodology as good as any in the world. However, no currently available system appears to be universally acceptable since universities are not all the same with some having significantly different aims and objectives from others. Notwithstanding the opportunity to discuss the outcomes from the IAF assessment, the assessment process will inevitably suit some universities more than it suits others.

There are two critical aspects that deserve attention. The first aspect is that since the universities and higher education system in general exists to serve Australia then it is important that a wide constituency has the opportunity to express its views in the assessment. There are a number of groups whose opinions on the performance of universities could also be taken

[1] For all references to Australian Higher Education practices, policies and paper, downloadable material is available at http://www.dest.gov.au

into account in an assessment but at present have no means of expressing their views. Examples of these groups would be Australian industry representatives and representative of the communities of which the universities are part as well as the Department of Education and Science. This leads to the need to undertake a multi-stakeholder analysis of universities' performance. The second aspect is the desire that the whole assessment process is transparent and auditable. While the IAF process has a consultative element, it is by its nature bilateral and hence opaque to others.

In addition to the IAF there are other assessment processes such as the Australian Universities Quality Assessment (AUQA) process and the Research Quality Framework (RQF). The former is a periodic whole-of-institution audits based on a self-assessment and a site visit. It addresses achievement in terms of the universities' missions and objectives and the adequacy of the institution's quality assurance arrangements in several areas including research. It also assesses universities' success in maintaining standards consistent with university education in Australia. The key operational mode is the use of panels of experts. The latter is intended as a transparent, acceptable and effective system that encourages positive behaviours in research. The process for research quality assessment requires that the RQF should focus on both the quality of research including its intrinsic merit and academic impact. In this context academic impact refers to the recognition of the originality of research by peers and its impact on the development of the same or related discipline areas. It also includes the broader impact or use of the research addressing the extent to which research is successfully applied. The process has several flaws with completeness, selective nomination of work to be assessed and the repression of non-academic assessors.

While both the AUQA and RQF are meritorious frameworks, neither can claim to provide an acceptable, in-depth assessment of all the research activities undertaken by universities since they treat research as homogeneous in nature and cannot claim to represent all the stakeholders involved in the research output of universities. The value of these

assessments has been questioned and it is felt that these evaluations provide such garbled results that they are useless for serious quality evaluations. Smith [Smith, 2000] produced a major critique of a similar scheme in Ontario, Canada. Furthermore, such a system of measurement should not induce a large administrative overhead in its operation if it were to be adopted as a regular assessment.

While no system with these characteristics is currently employed to assess universities, systems with these characteristics have been in use in the assessment and valuation of business for some years. While there are a number of modern business measurement systems known in the literature, most do not comply with the requirements of auditability and reliability, neither can they accommodate multi-stakeholder views without resort to meaningless averages.

III. AIM OF THE CASE STUDY

The principle aim of the study was to apply a modern assessment technique to the assessment of the value of research in an Australian university. The specific desired outcomes and constraints were:

1. A clear indication of the key performance areas for research at the university
2. Involved all the research of the university
3. An open and auditable process and system of calculation
4. The inclusion of all stakeholders
5. An usable measurement system with the minimum of operational overhead

IV. THE METHODOLOGY

The assessment technique chosen was the Conjoint Value Hierarchy (CVH). The underlying philosophy and operation of the CVH is described in detail by Pike and Roos (Pike, Roos, 2004).

An important distinction has to be made between conjoint measurement of which the CVH is an example and conjoint analysis, the standard approach used by companies seeking to design or improve their services. Conjoint analysis is in essence a process in which the detailed descriptors of a product or service are found and a measured mapping is developed to allow candidate products or services to be evaluated. Since the pioneering work of Green and others (for a review see Carroll, Arabie and Chaturvedi, 2002) there have been a number of modifications to the basic form such as Adaptive Conjoint Analysis (ACA) and Choice-Based Conjoint (CBC). The main disadvantages of conjoint analyses are that the number of combinations of features increases very quickly as more features are added and consequently the performance data gathering stage can be exhausting. Finally, it is difficult to use for product or service positioning as the procedure for converting perceptions about actual features to perceptions about underlying features is absent.

While conjoint analysis was being developed with a marketing bias, conjoint measurement was being developed in the field of psychometrics by Krantz, Luce, Suppes and Tversky (1971, 1989, 1990). This work was used by Green and Rao (Green and Rao 1971) to develop solutions to marketing and product-development problems and considered practical performance measurement issues. Later, conjoint measurement was combined with multi-attribute value theory (Keeney, Raifa, 1993), an extension of axiology or value theory (Frondizi, 1971 and Rescher 1969), to complex objects. This combination of theories led to the creation of functional conjoint measurement systems that could take real world performance measurements from multiple stakeholders and multiple design attributes and assess their relative merits.

This general approach has been developed by Pike and Roos into an analysis tool, the Conjoint Value Hierarchy (CVH), which takes performance measures and calculates the value of entities up to and including whole businesses but without the usual disadvantages of traditional conjoint analysis.

CVH is a non-consensual, multi-attribute conjoint measuring system. The mathematical measurement system is built in a two-stage process. The crucial first step is to define the scope of the problem, that is, the precise definition of what is to be measured and what is not. Given this definition, the stakeholders are identified on the basis of the ability to affect the problem owner because of the nature of the problem under consideration. The framework of Agle, Mitchell and Sonnenfield to nominate stakeholders is used (Agle, Mitchell, Sonnenfield. 1999). The framework uses the criteria of power, legitimacy and urgency to categorize stakeholders and goes on to categorize by importance with definitive stakeholders in the centre as most important.

In the first stage, a measurement structure is constructed which is inclusive of all opinions of what is important. This is achieved through an exhaustive top-down consideration and stops when it is felt that the resulting low-level attributes can be measured in practice. All opinions from all stakeholders are combined and attributes at all levels are tested for distinctness. This results in a measurement structure that is inclusive of all stakeholder opinions of what is important and in which the meanings of all attributes are distinct thus eliminating gaps and double counting.

In the second stage, the measurement structure is turned into an operational mathematical measurement system. Structurally identical versions of the system are customised so that there is one system per stakeholder which behaves mathematically as required by the stakeholder. In practice this means weighting the attributes, determining the behaviour of the combination algorithms and the relationship between performance and value. When this is done, data from real world performance measurements for each low-level attribute can be introduced and present value calculated from each stakeholder’s perspective.

V. THE STAKEHOLDERS, STRUCTURE AND ARCHITECURE

THE STAKEHOLDERS

The stakeholders were nominated by CDU and while they were inevitably not exhaustive, they covered the majority of stakeholder types who commission and use the results of research at CDU. The results would therefore be applicable to them but only possible to any other. 29 stakeholders were included in the study and represented:

- Government research bodies,
- Commercial users of research
- Professional associations
- Territorial Government
- Federal Government.

The CVH process offers anonymity both at the personal and organisational level so individuals and organisations are not named in this study. The benefit of this is that stakeholders feel free to give unfettered opinions.

THE STRUCTURE

The measurement structure that emerged from the literature survey and the first round of interviews with the stakeholders is given in Figure 1 below. It is significant that the first structure, based on the literature alone and following standard academic assessment practices was felt by the stakeholders to be inadequate. During the first round of interviews they made significant additions to the structure. This reflected their views that past performance alone was insufficient as a measure and that the entire process of selecting, commissioning and managing research had to be considered.

The subject/context is at the apex of the structure on the right and the meaning of the subject is progressively broken down into more detail in the successive levels to the left.

The three main areas of value: instrumental, intrinsic and extrinsic can be seen as separate branches arranged vertically with instrumental value at the top.

The instrumental branch is split into the timely and successful progress on work of importance to the sponsor and also the dissemination of ongoing research either by tacit means (personal interaction) or explicit means (interim or final reports). Together the instrumental branch covers the six elements of the Boisot Social Learning cycle (Boisot, 1995) and may therefore be considered to be a reasonable expression of the value of current research as it is executed.

The second main branch concerns intrinsic value and comprises the capability to administer a research programme and the intrinsic ability to carry it out. The administrative sub-branch is concerned with the ability to coordinate the diverse administrative branches (eg contracts, legal, commercial) and the speed of signing agreements and launching the work. The ability to carry the work out is represented by the quality of and access to existing knowledge, the necessary facilities and having motivated, capable and well led research teams.

The extrinsic main branch is devoted to reputation which is taken to mean the attractiveness of the university as a place to research, to be a member of faculty or to be a spin-off company. Finally, it is also take to include the more formal measures of achievement such as the publication record, citations and impact of previous work. Taken together, the extrinsic branch of the measurement structure encompasses the main features of the RQF.

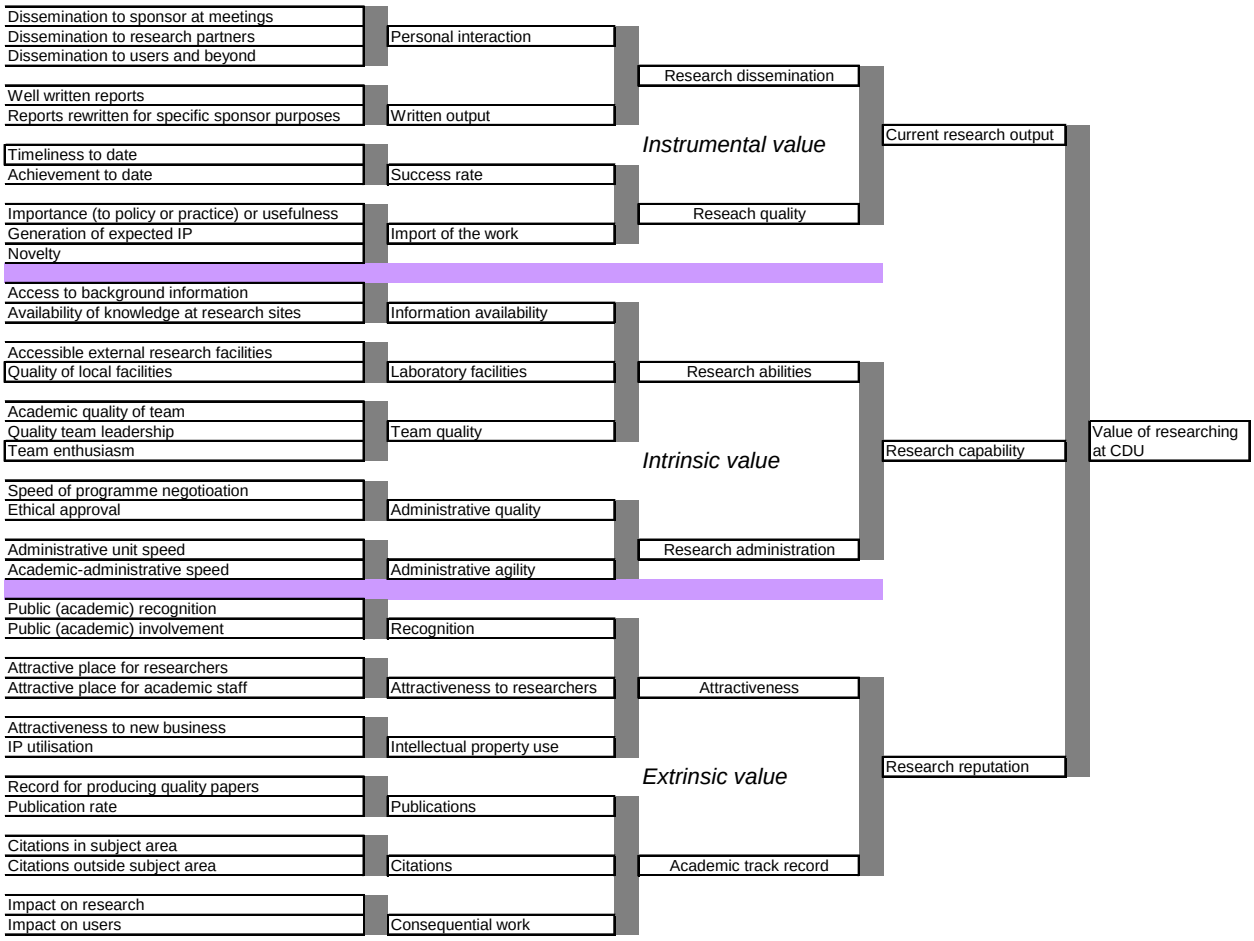

Figure 1 – The Empirical value structure

Each stakeholder has a copy of the numerical isomorph of this structure customised according to his/her views of value. In the numerical isomorph, the left-hand column is converted with the use of proxy measures which satisfy the criteria for acceptability and for which data can be collected.

The importance of the attributes is calculated by means of pair-wise comparisons in the manner pioneered by Saaty in the 1980s (Saaty, 1980). The relative importance of pairs (for convenience this is dealt with in branches) is entered into a binary combination matrix which calculates the importances of all attributes in the branch. The eigenvalue of the matrix is then used to estimate the coherence or consistency of the response. If responses in a branch appear mutually inconsistent then the weighting

process is reviewed and repeated. There were no instances of this in this study.

The aggregation algorithm used at combination nodes is continuously variable but has a limited range of practical settings since these roughly correspond to those of weighted addition, weighted multiplication and weighted vector addition with the vector origin set either at 0 or 1.

The limits of performance was simply collected and depended only on the stakeholders' views on firstly, the level of attribute performance which was lowest acceptable and secondly the highest level of performance they could reasonably expect. The limits of performance (P) are the only aspect of customisation in which the results from different stakeholders are used together. Since each has a different view the overall performance limits are that P_{min} (and its associated meaning) is the lowest definition offered by any of the stakeholders and P_{max} is the highest definition offered by anybody. Subjective views of current performance were elicited on this overall scale. PS_{min} and PS_{max} are the maximum and minimum suggested by any individual stakeholder and PS is a stakeholder's view of present performance on the overall scale.

Bringing performance onto a common scale and calculating the resultant input value is achieved by the transformation:

$$V = 0 \text{ if } PS<PS_{min},$$
$$V = 1 \text{ if } PS>PS_{max},$$
$$V = (PS-PS_{min})/(PS_{max}-PS_{min})$$

The intent of the study was to produce an operational measurement system for the university. This would require them to take periodic performance measures for the attribute. These would be measurements properly taken. However, it was also felt that a comparison with the subjective opinions of the stakeholders should also be sought and these were collected at interview using the 0 and 1 scale they had defined for themselves. This

activity permitted the testing of some of the later functions of the operational system and also served as a ready comparator for the university when it came to collecting its first real data.

ARCHITECTURE

The architecture of the CVH measurement system is simple and consequently its operation is also simple. Although CVH models have been written in native Visual Basic it is most common that they are built using Microsoft Excel with Visual Basic for Application macros programs to operate it. In some cases, limited ability to modify the model is also given but generally the computational element of the system operates as a “black box”. Figure 2 shows the architecture.

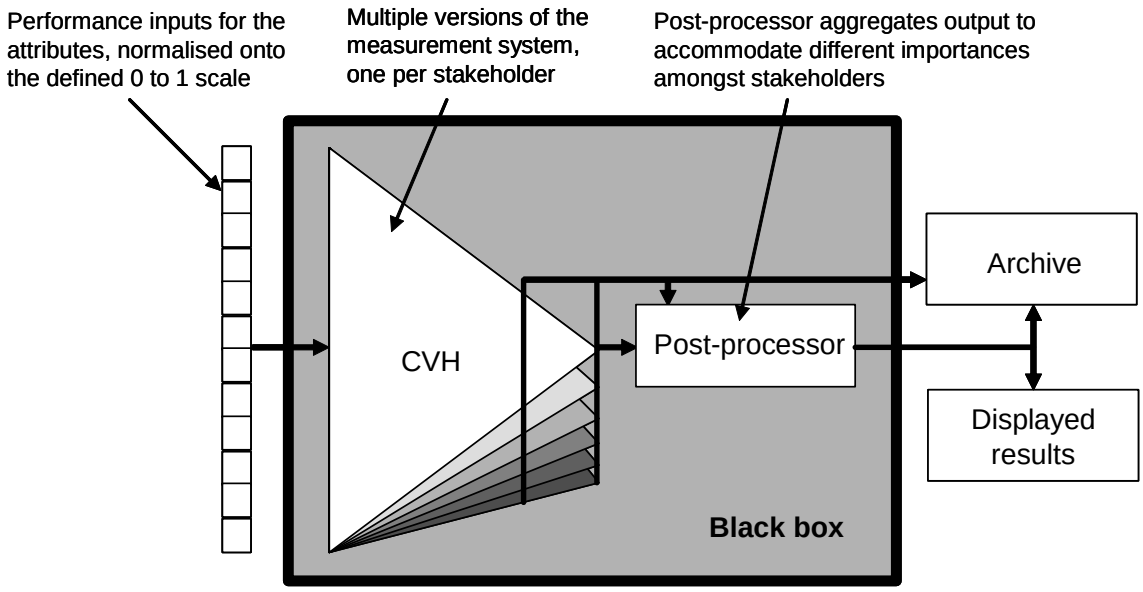

Figure 2 – Measurement system architecture

While post-processing is contrary to the spirit of axiology it is inevitable since manages and academics must make single decisions based upon the evidence. The CVH architecture archives both post-processed and raw results so there is no loss of information.

VI. RESULTS

Individual results were obtained for each stakeholder. For reasons of space, averaged figures are presented here as evidence to demonstrate the CVH approach as a means of developing a measurements system that meets the four aims of the study. The complete results are contained in the study final report (Charles Darwin University - Research Study, ICS Ltd, October 2005). Attaching different importances to stakeholders, while it may be done as a piece of post-processing to assist the manager in making decisions on courses of action, cannot influence a value calculation as it infringes the third and possibly the second axiology condition set below. The axiological approach has to be undertaken with rigor if it is to remain acceptable and to avoid disqualification on the grounds of subjectivity, a few simple precautions are required when employing axiology in practice. These embrace the principles of Lyons (Lyons, 2000) and are:

1. The object, company or part of company to be measured or valued is precisely defined
2. The definition is inclusive of all opinions and requirements from all stakeholders
3. All participants (stakeholders) have equal dignity or importance, at least ex ante
4. Every participant is accountable for the veracity of his/her position

As market valuations and internal strategic management decisions are the usual uses to which value assessments are put, the identification of stakeholders has to be undertaken with care as this can have a profound effect on the resulting decisions. In this study, such aggregation or exclusion is inevitable only one set of actions can be followed. In developing a working measurement system, the university has to specify the weightings given to each stakeholder. This is commonly made proportionate to the funding provided by the stakeholder now and the potential funding in the future. In the case of companies, the valuer selects the stakeholders whose views of the

value of a company he/she wants to include. Opinions that he/she does not want to hear can be excluded at this stage but with the risk that the picture that emerges will be incomplete and that some attributes of value, or elements of intellectual capital may have been excluded. For example, a company manager may nominate analysts, investors, customers, suppliers and regulators as stakeholder groups but exclude staff representatives with obvious potential consequences.

The value measurement structure as it emerged takes the scope of measurement far beyond the scope of the RQF in that it also measures process value, current delivered value as well as value based on past performance. It produces a combination of all three, that is, the current value of the subject: the value of researching at CDU. The subjective performance data corrected against the overall performance scale is given in Table 1. Note that these are subjective data based on opinion and not real measurements.

Table 1 – Attribute definitions, importance and current performance

Measurable proxy attribute	**Average score**	**Average importance**
Proportion of planned meetings attended by appropriate people	0.59	0.034
Proportion of planned visits to external partners appropriately attended	0.54	0.038
Proportion of planned visits to related users appropriately attended	0.57	0.033
Proportion of planned interim reports produced to expected standard	0.57	0.043
Proportion of reports rewritten for users at users request	0.56	0.034
Proportion of steps achieved at expected time	0.48	0.049
Overall proportion of outputs achieved	0.57	0.057
Importance (to policy or practice) or usefulness	0.55	0.060
Proportion of expected IP generated	0.37	0.026
Degree of academic novelty	0.40	0.026

Library size in relevant areas compared to Australian standards	0.54	0.020
Availability of IT-based knowledge at research sites	0.55	0.026
Relative ease of accessing research facilities	0.63	0.021
Relative quality of local facilities	0.63	0.028
Proportion of team at desired practical/academic level	0.52	0.054
Proportion of expected time devoted by the research leader	0.49	0.033
Absentee rate compared to other universities	0.56	0.041
Speed of programme negotiation	0.46	0.024
Proportion of "appropriate people" on the ethics committee	0.54	0.027
Average time to involve all required departments compared to others	0.48	0.038
Speed of launching agreed programmes compared to other universities	0.47	0.033
Awards received compared to best of the other universities	0.48	0.016
Invitations to lecture (number / faculty)	0.43	0.020
Proportion of graduates remaining at CDU	0.46	0.028
Balance between top faculty leaving CDU and applicants for the posts	0.40	0.031
Number of spin-off companies launched/yr compared to others	0.26	0.012
IP portfolio increase per year compared to other universities	0.25	0.015
Proportion of peer reviewed papers (cf non-reviewed)	0.47	0.029
Peer reviewed publications/faculty compared to other universities	0.46	0.015
Proportion of in-subject citations per paper	0.57	0.019
Proportion of cross-disciplinary citations per paper	0.43	0.020
Proportion of projects leading to follow-on research	0.49	0.023
Proportion of projects that have made a (significant) difference	0.32	0.027

The processing and aggregation of the performance data and attribute importances in Table 1 gave the top-level value results shown in Table 2.

Table 2 - Importance and value outcome for the top-levels in the system

Value criterion	Importance	Value result
Current research output *(Instrumental)*	0.400	0.474
Research capability *(Intrinsic)*	0.343	0.481
Research reputation (Extrinsic) *(Roughly equivalent to the RQF)*	0.257	0.396
Overall score for "the value of researching at CDU"	1.000	0.455

The CVH process builds a complete picture of the values of each stakeholder concerning the value of research at CDU. Normally these are kept separate to conform to the requirements of axiology but have, for the sake of brevity, been combined. Each stakeholder has been given equal importance. The completeness of the analysis permits a landscape to be constructed. In Figure 3 the surface plots depicts the average of the surfaces for the stakeholders. The horizontal axis shows the attributes of value. The front-to-back shows the performance against each attribute the 0 to 1 scale with 0 at the front. The vertical axis shows the calculated value. The plot is a sensitivity plot. Initially, all attributes were given an arbitrary performance score of 0.5. The performance of one attribute is then set to 0 and increased incrementally to 1 and the value result for the whole structure calculated. The process is then repeated for all remaining attributes. The surface that emerges show which attributes make the biggest change to value if they are varied. This is therefore a sensitivity plot.

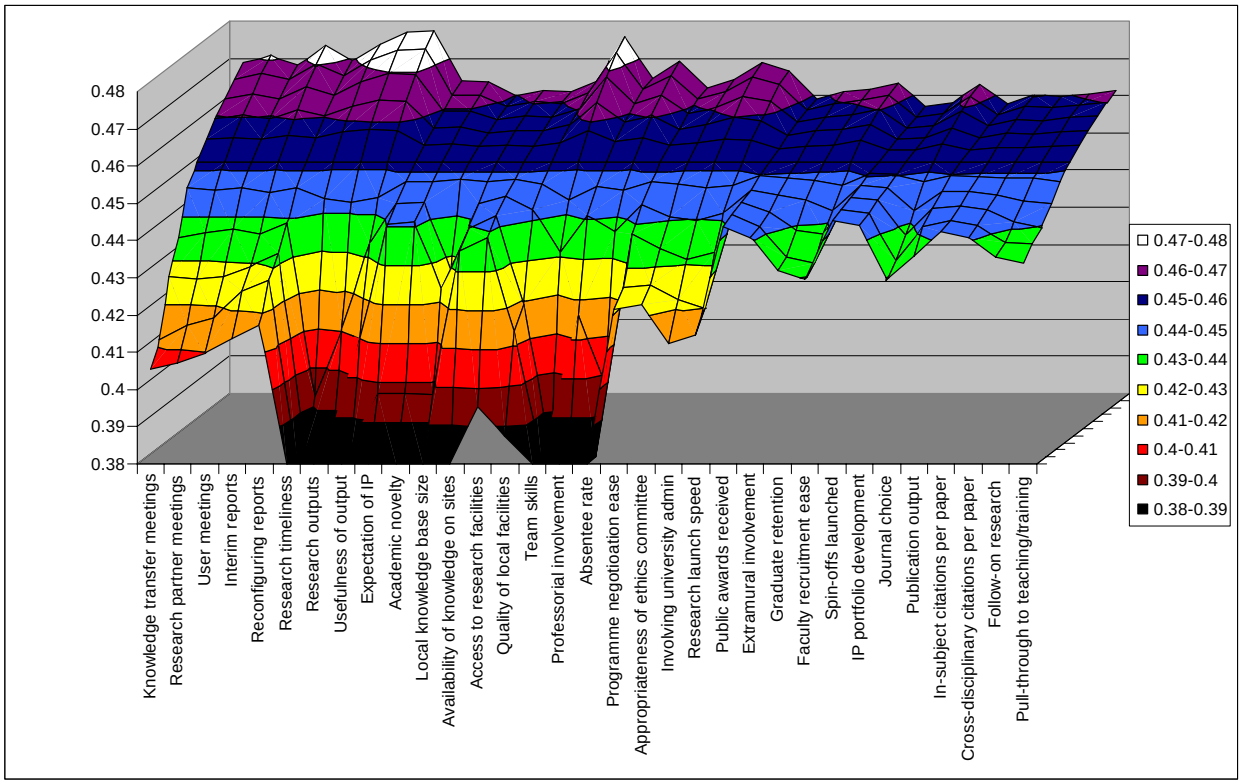

Figure 3 – The averaged value surface

It is generally true but simplistic to say that the attributes with the highest peaks and the lowest valleys are those to which the structure is most sensitive. Areas where there is little vertical variation are areas where none of the stakeholders considered important. It will be noticed that the downside of the plot is often much greater than the upside. This occurs especially in those attributes concerned with the quality and impact of current research. This arises, for example, if research with immediate potential application is delayed or of poor quality and the opportunity to use it is missed; in these circumstances it may be judged as worthless by stakeholders. Obviously this situation does not arise with historical work in the reputational area where such issues are of no consequence. Figure 4 shows the height range by attributes but sorted by those which have the highest potential to add value.

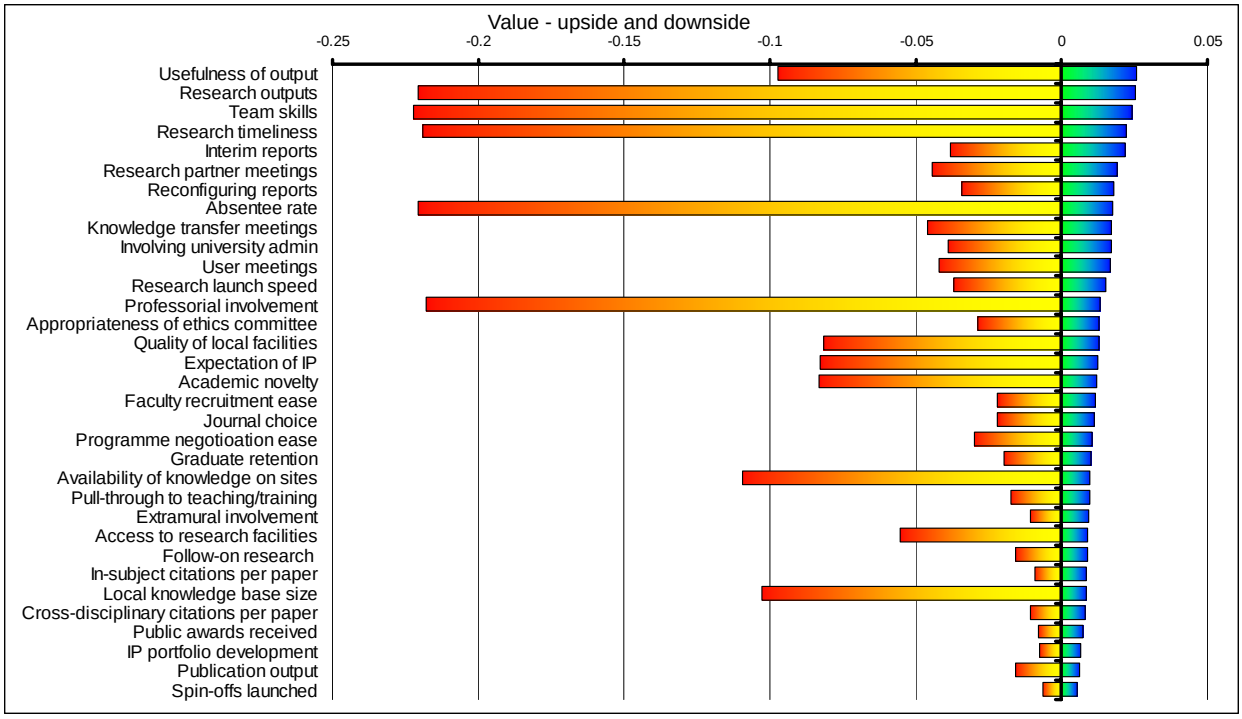

Figure 4 – Sorted attribute importances

The information contained in the plots is valuable to the university since it displays the sensitivities of stakeholders and shows the areas to improve performance to be of greater value to them and areas where loss in performance could be catastrophic. It should be noted that these are calculated figures of value and academic excellence and the current RQF process are only part of the picture. In practice one value surface is constructed from the individual surfaces of all stakeholders taking part in the assessment. This is akin to achieving consensus in the current RQF process except that with a mathematical combination, all views of value can be weighted and combined which removes any accusations of disenfranchisement which may occur in a consensus process.

CVH also presented the data in tabular form prioritised in terms of sensitivity and on a 0-100 scale. The meaning of the results in the table is that those shown, the top 10 of the 33 attributes are those have the greatest impact on delivered value. Each stakeholder has his or her own top 10 but again, aggregated results are shown. Table 3 shows the results.

Table 3 – Sensitivity of value to attribute performance

Team skills	100
Research outputs	100
Research timeliness	98
Absentee rate	97
Senior academic involvement	94
Usefulness of output	50
Availability of knowledge on sites	48
Local knowledge base size	45
Academic novelty	39
Expectation of IP	39
Quality of local facilities	38

The value figures shown in Table 2 were calculated using the subjective performance data of the stakeholders. The surface plot shown in Figure 2 can be adapted and the current performance plotted as a line on the surface. Figure 5 shows this using the subjective performance data.

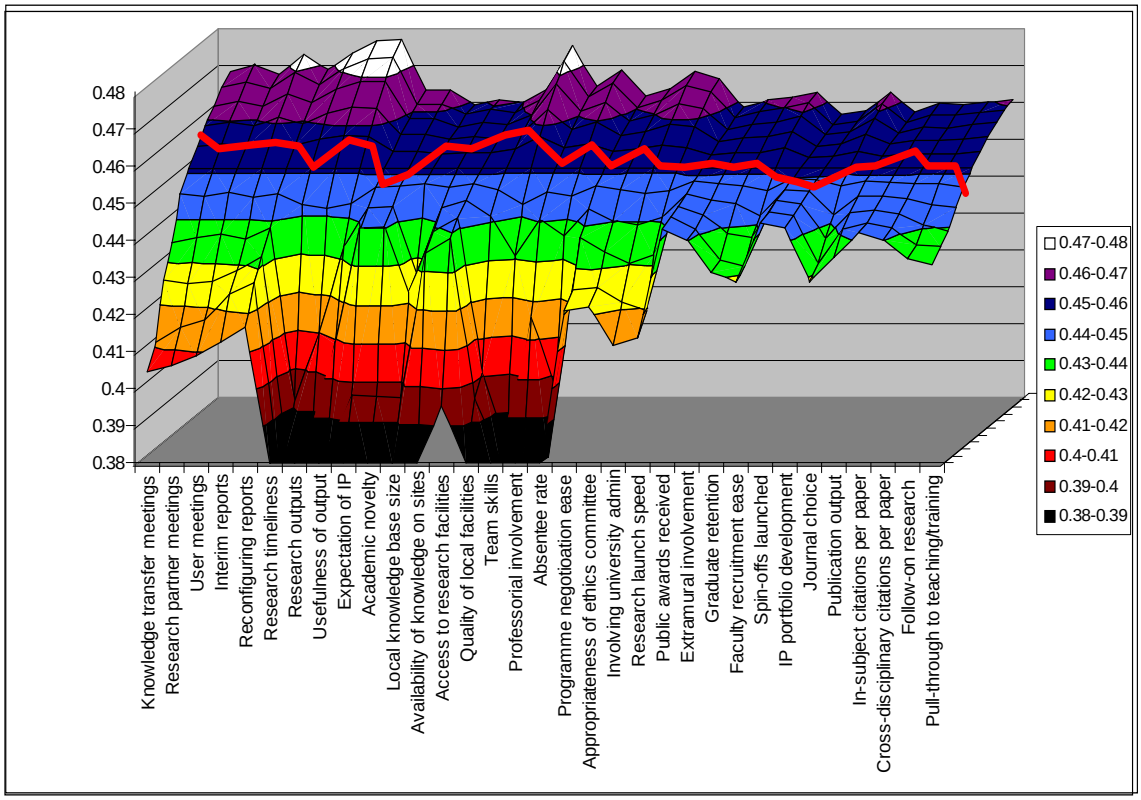

Figure 5 – Sensitivity surface with current performance overlay

The university can use this information to target investment or for performance improvements, especially the avoidance of the catastrophic loss of value attendant upon the current performance line descending into the valleys. As with the sensitivity chart, this data can be presented in bar form with the attributes prioritised according to greatest benefit. In the Figure 5, a ±10% performance change has been assumed and the change in value calculated.

Figure 6 shows a smooth gradation of attribute value changes with the single exception of research timeliness where there is a very large downside. This occurs as the current subjective performance levels line is close to a part of the value surface where there is a rapid drop to low value. As with the sensitivity information, CVH also provides the top 10 as a prioritised table on a 0 to 100 scale. This is an extremely valuable table since it give a prioritised action list to improve performance and hence delivered value. Table 4 gives the results, again using the subjective performance information as the input.

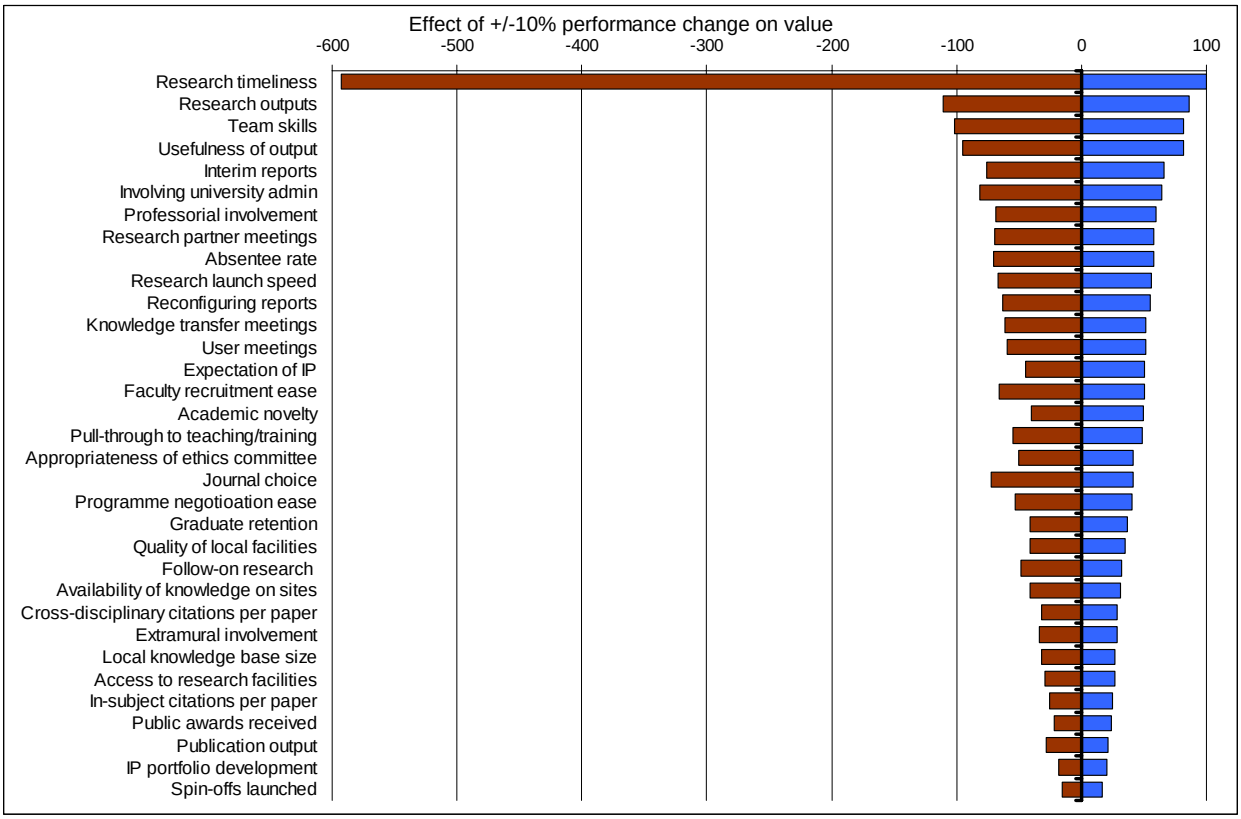

Figure 6 – Sensitivity of value to a ±10% change in current performance

Table 4 – Prioritised top 10 attributes for performance improvement

Research timeliness	100
Research outputs	28
Team skills	26
Usefulness of output	26
Involving university admin	21
Interim reports	21
Absentee rate	19
Senior academic involvement	18
Research partner meetings	18
Research launch speed	18

While the purpose of the case study was to demonstrate that better, more comprehensive and more representative means of valuing research are available it is clear that the university is scoring well according to the subjective judgements of its research stakeholders. More encouraging is that apart from one performance attribute, the university scores well in the critical areas where the stakeholders are most sensitive to performance change.

VII. CONCLUDING COMMENTS

In operation, the CVH requires performance data inputs for each of its low-level attributes. In the system constructed to measure the value of the research of the university there were 33 such attributes. This compares closely to the data requirements of many popular performance management systems such as the balanced scorecard although the balanced scorecard is only ever a collection of ill-defined performance measures. Critically, it lacks the “so what” factor whereas the CVH specifically addresses what stakeholders value.

CVH measurement systems require more effort to construct than simpler approaches in that they require two separate interview sessions with stakeholders to define then customise the measurement system. However,

stakeholders can be left alone once the customisation has been completed unless the following significant changes occur:

1) There is a significant change in stakeholder attitudes
2) There is a significant change in stakeholder identities or numbers
3) There is a significant change in the nature of the research being valued

CVH measurement systems provide a wealth of useful information about what matters to stakeholders, even before data is entered. Processed data then gives detailed value results and prioritises the areas where poor performance is currently leading to severe value loss, where performance improvement can make the greatest impact and where further or unplanned performance loss has the most severe consequences.

The aims of the case study were to produce a measurement system that:

1. A clear indication of the key performance areas for research at the university
2. Involved all the research of the university
3. An open and auditable process and system of calculation
4. The inclusion of all stakeholders
5. An usable measurement system with the minimum of operational overhead

It is clear from the results section that the sensitivities of research value have been explored and the key areas exposed and, perhaps more importantly, the key improvement areas. The nature of the CVH measurement structure with areas that broadly address current and past performance as well as infrastructure and the potential to undertake research is clearly broadly based and has the potential to involve all university research. While the system operates as a black-box, this is usually for commercial reasons or to avoid inadvertent damage. Otherwise there is no reason why the whole system should not be open. The case study involve 29 stakeholders, while this may

not be complete it could have been made so if time permitted. Finally, once the measurement system had been set up, the live and repeated operation of it is simple.

It may fairly be claimed that the CVH system met the requirements asked of it.

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