

Ensuring the advancement of metrology in areas supporting sustainable development through improvements in the budget allocation process

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Abstract: metrology is developing as a field, and in the United Kingdom (UK) this requires development of the budget allocation process to ensure funding is provided to all areas. A research project is being undertaken within the UK National Measurement System aimed at creating a more balanced approach to ensure funding is granted at the appropriate level in areas of metrology for which the justification is non-economic.

Keywords: decision making, metrology, sustainable development.

1. INTRODUCTION

Metrology has historically been considered to mainly impact within and on trade and industrial processes. The changing face of metrology is ensuring this is no longer the case. It has been recognised that metrology impacts on a wide range of elements in the UK [1]. The pattern of development witnessed within the field of metrology and the changing approach to development since the Rio Convention 1992 has led to the need for a change in the approach the UK Government uses to allocate budgets for research and development.

2. PURPOSE

The National Measurement System Directorate (NMSD) is part of the Department of Trade and Industry (DTI) within the UK Government. As such it is in charge of allocating an annual budget of about £60 million to deliver; “world-class measurement science & technology and provide traceable and increasingly accurate standards of measurement for use in trade, industry, academia and government” [2].

The evolution of metrology into areas with reduced economic impacts requires a change in the process used for the allocation of the NMSD annual budget. The budget allocation process within the NMSD uses a system of Multi Criteria Decision Analysis (MCDA). The current methodology emphasises the economic impacts of metrology. To ensure appropriate spending on metrology research and development in areas supporting sustainable development (SD) changes to this system are required. The potential changes are in association with UK Government policy on SD. The UK created a set of 120 SD indicators in 1992 [3], which have since been developed into 15 headline indicators [4].

As a consequence a research project was set up to create a mechanism to improve the recognition of these aspects for the purpose of budget allocation. The aim of this paper is to describe the process being considered to improve the balance of funding for emerging areas of metrology research, in social and environmental spheres. The development of the mechanisms aims to overcome the witnessed disparity by creating a more balanced funding split.

3. METHODS

Research conducted by the Council for Science and Technology (CST) in the UK highlighted the requirement for the use of “non-expert and non-partisan perspectives” [5]. As a result the mechanism being created aims to incorporate human judgement and quantitative data in the decision making process.

It is often perceived that judgement equals choice. Although when considering human behaviour and psychology it maybe clearer to consider judgement to be an aid to choice. The application of judgement leads to a reduction in uncertainty and conflict in a choice made using a process of reasoning [6]. The involvement of human judgement also allows for subjective perspectives [3] to be applied and the quantitative data enables for some objectivity to be introduced into the process.

A trial has been implemented in regard to the development of the human judgement section of the mechanism. This mechanism works using a Likert approach, to provide a systematic approach for advisory group members to score the sub projects of a proposed metrology programme. The mechanism is based on three questions and these are:

A: What is the potential level of non-economic effect on an individual as a result of this sub-project?

B: What percentage of the population is it believed will be affected by this specific intervention?

C: How long will the perceived benefits of the project last?

The Likert approach is based on the creation of statement answers for each questions and participants are asked to select the most appropriate statement. The statements for the purpose of this mechanism are:

| Score | Question A | Question B | Question C |
|-------|---|------------|---------------|
| 1 | Causes death, very serious environmental damage or weaken UK security | 0-20% | 0-2 years |
| 2 | Significant negative health, environmental or security impacts | 21-40% | 3-4 years |
| 3 | Negligible negative health, environmental or security impacts | 41-60% | 5-6 years |
| 4 | Neutral effects | 61-80% | 7-8 years |
| 5 | Minor health, environmental or security benefits | 81-100% | 9-10 years |
| 6 | Significant health, environmental or security benefits | | 10 years plus |
| 7 | Strongly improves health, the environment or security | | |

This trial was undertaken with the assistance of staff from the National Physical Laboratory and the advisory group members that currently assist with the prioritising of programmes. Two simple formulae are applied to the data collected to create a comparable figure for the MCDA computer model used. The formulae are as follows;

$$\text{Benefit Value (BV)} = A, B, C$$

$$\text{Benefit Cost Ratio (BCR)} = \frac{\text{BV}}{\text{Cost}}$$

The aim of this mechanism is to create a system where human judgement can be applied in a systematic manner to represent non-economic benefits. These can then be compared to the economic benefits generated from more traditional sub-projects within a given metrology programme. Consequently, aiming to balance the funding split within metrology programmes and in turn potentially increasing spending on non-economic metrology research.

4. RESULTS

Research has shown that the creation of single values for each sub-project enables comparisons between environmental, medical and security areas where impacts are felt. It is believed the use of the BCR value within the MCDA model will raise the profile of novel metrology research.

Further development of the human judgement mechanism is required in a number of areas. One of these is the definition of negligible and significant as used in the Likert scale, as this appears to be an area requiring clarification. Secondly research is required in relation to question B and gauging the percentage of population affected by a given sub-project. This potentially could be overcome with the provision of further information, although as it is based on judgement it may be considered to complicate the process and not provide an enhancement in the decision-making approach created. The human judgement based mechanism is not going to be used solely as a mechanism in this process. The quantitative approach being considered will be discussed in the next section.

5. DISCUSSION

The evolution of the mechanisms is based on decision-making theory and the novelty of this work is its application mode. There is little work on allocating budget for the purpose of advancing metrology in general and more

specifically for aspects concerned with SD. The areas being considered are mainly in regard to environmental and medical metrology due to the nature of and application of measurement technology in the UK. The mechanism being devised is also hoping to cover security in terms of military or anti-terrorist advances.

The second mechanism currently being considered involves the application of quantitative data. The aim is to demonstrate trends in the data and thus areas where impacts can be felt through improvements in metrology. This will consider the environmental, medical and security impacts as economic impacts are covered separately within the model.

From the initial trial of the human judgement mechanism it appears secondary data could be beneficial to the process both for participants scoring and as an input to the MCDA model. The application of both mechanisms will enable the creation of a system, which aims to recognise and consider all aspects of metrology and the potential impacts in the decision making process.

6. CONCLUSION

The development of these mechanisms are in their infancy in regard to implementation. Work currently being conducted is demonstrating positive outcomes but requires a full trial in the formal context in which priorities are set to identify aspects that need improvement and where issues exist. The development of such a mechanism is a necessity and consequently will cause a change in the approach of the laboratories in respect to the number of projects put forward in non-traditional metrology areas.

The UK NMSD will be well served by shifting its focus of metrology towards broader social and environmental objectives as the British economy continues to shift from a manufacturing based to a service based economy. Government policy makers and Ministers want stronger impacts at the level of the individual citizen inline with their numerous objectives. As a consequence of this SD issues are the means by which the NMSD can and should expand its impact areas. Hence the need for the development of the mechanism put forward in this paper.

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REFERENCES

- [1] PA Consulting Group, 1999. Review of the Rationale for and Economic Benefit of the UK Measurement System
- [2] National Measurement System Website, 2002. <http://www.dti.gov.uk/nms/about/index.htm>
- [3] HK.Chiou, GH. Tzeng, DC. Cheng, "Evaluating sustainable fishing development strategies using fuzzy MCDA approach," Omega, The International Journal of Management Science Vol, 33, pp. 223-234, 2005
- [4] Defra 2005, The UK Government Sustainable Development Strategy. HMSO: London
- [5] Council for Science and Technology, 2005. Policy through dialogue: informing policies based on science and technology. Report can be found at: <http://www.cst.gov.uk/cst/reports/#8>
- [6] Einhorn, H.J., Hogarth, R.M., 1988. Behavioural decision theory: processes of judgement and choice. In: Bell, E., Raiffa, H., Tversky, A., 1988. Descriptive, normative, and prescriptive interactions in decision making. Cambridge University Press: Cambridge UK