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Exploring the impact of evaluating strategic options in a scenario-based multi-criteria framework

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ABSTRACT

One of the least explored aspects of scenario planning is how to assess systematically the value and robustness of strategic options after scenario development. In this context, there is growing research interest on the use of multi-criteria decision analysis (MCDA) to evaluate such options, but with very limited evidence about its performance in practice. This paper examines effects of applying in practice one of those recently proposed scenario-based MCDA methods for identifying robust options. Three public sector decision-making instances in Trinidad and Tobago are examined within an action research framework to provide insights on differences in decision-making behaviour and areas for improvement of the method. Findings from these in-depth case studies indicate that the method's main benefit was that it stimulated curiosity on how options might be improved in order to mitigate negative consequences and capitalise on opportunities across scenarios. We conclude the paper by discussing these findings and their implications to the development of the method and the evaluation of strategic options under deep uncertainty.

1. Introduction

Deep uncertainty is characterised by unavailability of well-validated, trustworthy risk models giving the probabilities of future outcomes; disagreement about the likely impacts of alternative options; and uncertainty about available alternatives, resulting in a premature focus on salient options, which are not necessarily the best that could be devised [1–3]. Decision-making tools under deep uncertainty fall into two main areas: finding robust decisions that work acceptably well for many models in the uncertainty set; or learning what to do by well-designed and analysed trial and error [3].

Scenario planning, a systematic process for defining the plausible boundaries of future states of the world, is particularly useful in environments where deep uncertainty prevails, and aims to identify and create robust strategic options (i.e., reasonable performance across a range of scenarios) [4–10]. Multiple, conflicting objectives also exist in such contexts. This has led to a growing interest in using scenario planning with multi-criteria decision analysis (MCDA[1]) [11–22]. Some approaches have employed best-case, worst-case and most-likely outcomes; while traditional scenario planning supports the presentation of hypothetical futures that plausibly evolve from the present, each influenced by different drivers/key events [23,24]. Inter-scenario risk and robustness measures [20]; or threshold levels for performance for all scenarios [13,21] have been suggested as evaluation metrics across multiple scenarios, although it remains an open question whether performance should indeed be compared across scenarios.

One of these methods, which we proposed recently [25], systematises the evaluation of options under $(2x+2)$ scenarios defined by a combination of extreme levels of x key uncertainties, where x is a small integer number. Such scenarios are employed to trigger a different set or strength of preferences among multiple objectives [26], important for developing an appreciation of

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[1] MCDA refers to multi-criteria decision analysis, a technique for managing multiple conflicting objectives.

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the multiple constructions of the policy process [27,28]. We based our selection technique on the assertion that extremes help one to consider a large range of variability for key uncertainties identified [29], and a consistent finding about the characteristics of extreme scenarios in a broader set defined by combinations of uncertainty outcomes. While the benefits of developing a scenario narrative are not to be understated [30,31], our method focussed on evaluating option robustness. We were cognizant of the heavy cost incurred in terms of time to develop narratives [32] in light of subsequent stages in the process. We instead created scenario snapshots/vignettes, consistent with findings that brief scenarios do not impact the benefit of accepting a broad set of outcomes [33]. We adopted regret (i.e., under-performance of an option in a given scenario relative to the best performing option in that scenario) as the operator to assess robustness as advocated by [2]. It has been asserted as one of the more credible criteria for selecting decisions when likelihoods are not known with sufficient precision, as exists under deep uncertainty [34]. We also employed a way of normalising different value scales under each scenario using cost equivalents as suggested by [35].

This paper aims to understand the extent to which characteristics of this method prompt a coherent portrayal of option evaluation under deep uncertainty. We measure coherence in terms of the extent to which it provides a comprehensible process, uses meaningful and relevant information, encourages active questioning of strategic priorities, and stimulates option improvement. We do not claim that the method is fully developed, but offer potential causal explanations of how decision makers in similar contexts might improve the quality of their existing processes through this method. This investigative analysis suggests on how our own proposals might be improved, and our finding may help further develop such stream of research. This is informed by our learning with and from participants, and previously developed relevant scenario planning and MCDA theory.

Given the aim of the inquiry, an action research strategy of inquiry was applied. It has been suggested that such research design is aligned with the mode of inquiry suitable for understanding scenario planning [36,37] and MCDA interventions [38–40]. Comparing our method to existing processes (as opposed to competing methods) also aligned with our aim, and with previous effectiveness studies [41]. Quality dimensions selected were aligned with the literature [42]. Three public sector projects in Trinidad and Tobago, involving option assessment, were used. This particular context was chosen as different areas were being reviewed to meet objectives of a 2020 development plan for the country. In each case we initially surveyed the diversity of opinion insofar as interviewing those who would typically provide information inputs to the decision process (as identified by the decision maker) to establish agreement of uncertainties and objectives. Subsequently, a single decision maker was used as we wanted to gain an understanding of the decision support method in its lowest common denominator of involvement. However, we also engaged in discussions with others involved in the decision-making process to understand the critical aspects of the problem under consideration and so identify and understand some of the major distinctions that mark central actors or stakeholder groups [43].

The paper is divided into five sections. First, we provide the rationale for key features of our decision support method. Next, we describe the research methodology. Then we discuss application to three cases, examining possible reasons for discrepancies between current decision practice and our proposed method. Subsequently, we compare findings across cases to evaluate benefits of the method, acknowledging that our methodology is limited in its ability to provide generalizable contributions. We conclude the paper by identifying tentative contributions and scope for future research in this area.

2. A decision support method for MCDA evaluation under multiple scenarios

Several methods have been recently suggested in the literature for scenario generation and option selection with MCDA [11–22]. Three features differentiate our decision support method: the scenario generation technique, the use of cost equivalents, the use of regret for measuring robustness, and cost equivalents for comparing results across scenarios [35]. The scenario set systematises evaluation of options under $(2x+2)$ scenarios defined by a combination of extreme levels of x key uncertainties, where x is a small integer number (see Fig. 1 for details). We wanted to not only achieve a scenario set that provided the sense of ownership created by the scenario planning framework through a small number of detailed narratives [24], but also provide a representative sample to better support weighting of judgments as advocated by risk management frameworks [44]. Given that extremes help one to consider a large range of variability for key uncertainties identified [29], we asked decision makers to consider most likely, worst possible and best possible outcomes for key objectives Debate between the decision maker and facilitator sought to construct inherently plausible arguments for why a more extreme outcome would be implausible in the time horizon considered [18,45]. All possible combinations of outcomes then defined the scenario set. Assuming equal weight for each uncertainty, we then defined extreme scenarios as those that were significantly different from the most likely scenario. We measured distance from the most likely outcome in terms of the percentage of overlap of outcomes between that scenario and another in the set [46]. We then examined characteristics of those scenarios that were most different from the most likely scenario (i.e., low similarity to the most likely scenario). For any number of uncertainties, this set was characterised by the scenarios with best possible outcomes on all uncertainties; scenarios with worst possible outcomes on all uncertainties; and scenarios with the worst possible outcome for one uncertainty given best possible outcomes on all others (repeated for each uncertainty); and vice versa (see Fig. 1).

While the benefits of developing a scenario narrative should not be understated [30], we were cognizant of the heavy cost incurred in terms of time, which could eventually affect the benefit perceived from scenarios [32]. Given that brief scenarios, not causally linked, do not impact the cognitive benefit of accepting a wider range of outcomes [33], we created scenario snapshots/vignettes, each composed of a common module (trends) and an experimental cues module (combinations of uncertainty outcomes selected). We presented these to the decision maker for feedback on their clarity before applying the MCDA framework