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A method for evaluating the funding of components of natural resource and conservation projects

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ABSTRACT

Many public and private entities such as government agencies and private foundations have missions related to the improvement, protection, and sustainability of the environment. In pursuit of their missions, they fund projects with related outcomes. Typically, the funding scene consists of scarce funding dollars for the many project requests. In light of funding limitations and funder's search for innovative funding schemes, a method to support the allocation of scarce dollars among project components is presented. The proposed scheme has similarities to methods in the project selection literature but differs in its focus on project components and its connection to and enumeration of the universe of funding possibilities. The value of having access to the universe is demonstrated with illustrations. The presentation includes Excel implementations that should appeal to a broad spectrum of project evaluators and reviewers. Access to the space of funding possibilities facilitates a rich analysis of funding alternatives.

1. Background

Many government agencies, foundations, institutes, universities, and other entities have missions related to the improvement, protection, and sustainability of the environment. In pursuit of these missions, they invite proposals for a wide variety of environmental improvements. Through grant making, they fund projects that promise outcomes in the environment such as reductions in the pollution of water and air; protection of endangered species; sourcing, treatment, and delivery of clean drinking water; development of biodegradable materials; waterway cleanups; eradication of exotic or invasive plants; re-vegetation efforts; watershed protection; wetlands conservation; and many others. The list of sought-after environmental improvements appears unlimited. It stands in sharp contrast to the scarce dollars these entities have to bring to the grant making. As a result, an economizing problem arises, i.e., how to allocate scarce funding among the numerous requests for support in improving, protecting, and conserving the environment. This is referred to herein as the natural resource and conservation (NRC) funding problem. This paper presents a method for its examination.

Consider the following characterization of the contemporary funding landscape that is due to Anonymous (2015). "Funders have limited resources. The majority receives far more requests for support than they can fund which is leading many funders to consider ways in which they can use their funding more efficiently and effectively. This is changing the forms of funding on offer from organisations (both public sector and private) which formerly offered grants, and also the application and assessment processes for grants. Some funders are moving away from just supporting project or capital costs (equipment, buildings etc.) in favour of strengthening an organisation' position by supporting its development costs." Development is understood here as reference to proposed project interventions with promised outcomes and impact that relate directly to funder interest. Agol et al. (2014, p.3) provided insight to project development features and their breadth in a project proposal. "As a result, a suite of 14 "Integrated Social Programmes" were developed with diverse themes ranging from full-time education and vocational training, community health, water, hygiene and sanitation (WASH), HIV/AIDS awareness to enterprise development and business empowerment." Consider too how NRC projects are reviewed. Lahlou and Canter (1993, p.42) noted that many stakeholder groups are involved in the scoping and review of environmental projects. "They include project proponents; lead agencies; agencies charged with legal and technical review; expert opinion; local and state government entities; and concerned/affected citizen groups." Consequently, a variety of decision criteria (funding objectives, requirements, restrictions, etc.) can be brought to the evaluation process resulting in perhaps as many different funding recommendations. Consider also the nature of recommended environmental decision support technology. McIntosh et al. (2011, p.1391) recommended that such technology for environmental problem solving should utilize simple design tools and lend itself to the discovery and evaluation of options. Accordingly, if environmental projects are viewed as a collection of components that in outcome and impact relate to funder interests and mission; if the review mechanism facilitates inspection and analysis of a variety of funding alternatives; and if a simple computational support tool for producing and evaluating funding alternatives is utilized, then a project

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review support tool so oriented is aligned with the needs of the contemporary funding scene. This is the orientation of the proposed method for investigating the NRC funding problem.

The NRC funding problem fits within the class of allocation problems known as project selection where a decision maker determines how to assign scarce funds among a given set of projects and in doing so achieve certain objective(s) such as funding the maximum number of projects within available funds. Early discussions of the project selection problem appeared in Souder (1973) and Souder and Mandakovic (1986); recent literature reviews in Heidenberger and Stummer (1999) and Clark (2015); contemporary mathematical modeling of project selection in Duzgun and Thiele (2010); Liesio and Punkka (2014); Roland et al. (2016) and discussion of the role of project stakeholders in the decision process in Voropajev and Gelrud (2012). The problem may also be looked upon as a variant of the menu selection problem, Lancaster (1992); the technology selection problem, Ahmed and Shahinidis (2008); vendor selection problem, Ipsilandis (2008); and aspects of the fixed charge transportation and the facility location problems, Hillier and Lieberman (2005). Generally, these treatments of the selection problem do not consider funding common project components but they do share with environmental project selection the scarcity of funding resources as well as the need for an allocation scheme and efficient software implementation. In a very different context, the kernel of this paper is similar to Palmas et al. (2015) in that it too explores the decision space of solutions in an efficient way. Sources for material related to the content of NRC project proposals included public entities such as the Pennsylvania Department of Conservation and Natural Resources, Anonymous (2014); Salo et al. (2004); Taylor and Keown (1978).

In the funding setting addressed in this paper, a project is looked upon as a set of well-defined funding requests related to environmental conservation, improvement, and protection that are of interest to the funder. The objects of the requests are the features/components pertinent to the proposed method. For example, a project may request funding for updating and expanding a site's capacity for potable water and waste water treatment. They may be referenced as features by the same names or collectively as a clean water improvement feature. The funding request may also have a provision for educating the site's populace about potable water sourcing and disposing of waste water. This may be looked upon as a clean water education feature that may be consistent with the funding entity's interests and labeled as such with the other two features. A reviewer may believe that the three features should be funded collectively and not in any other combination. This is an instance of reviewer decision/funding criteria to be observed in evaluating funding options. Other reviewers may not be in agreement with this requirement and consequently seek funding options to the contrary. For this reason, a method that facilitates inspection of a variety of funding scenarios/options has value. In this paper, the scenarios consist of funding just one common project feature among the projects under review, pairs of common features, triples, etc. In doing so all possible exclusions and inclusions of project features are accounted for and constitute the universe of funding possibilities. In this manner, reviewers can identify and evaluate funding scenarios of interest to them and those of interest to other review parties under a variety of funding criteria. Unlike the decision to fund/not projects in whole, the interest here is funding/not project features (parts).

2. Purpose and objectives

The proposed method is intended to support investigation of funding alternatives. It is a scheme for examining the allocation of scarce funding dollars among project features that are directly related to outcome/impact of most interest to the funder and the project review parties. Decomposing projects into features so aligned is proposed as a way to address the economizing problem faced by the funding entity. In practice, the proposed method enables an NRC project reviewer to: i) enumerate many and if necessary all funding possibilities; ii) evaluate the funding possibilities under a variety of decision criteria; and iii) discover, compare and confirm the suitability of funding scenarios in a simple computational environment. As such, the approach is consistent with the contemporary funding environment characterized in Section 1.

The proposed method supports assessment that Stauth et al. (1993, p. 14–15) defined as "the process of collecting, organizing, analyzing, interpreting, and communicating data relevant to some decisions."

3. Method

Decomposition of projects into features is a central aspect of the proposed method. Component features may relate to making public lands and resources such as parks, recreational sites, forests, wilderness areas, monuments, and the like accessible, environmentally friendly in operation, compliant with federal and state statutes, sustainable, habitable for indigenous flora and fauna, or the locus of scientific studies and educational programs related to the environment. Handicap access, environmental programs for targeted populations such as individuals with special needs, waste management improvements, storm repairs, and compliance with governmental clean water and air statutes are a few examples of specific project features. A given feature need not be a component of every funding request under review. The funding entity may be a solo funder or function as a co-funder. Consistent with the McIntosh et al. (2011) call for simple environmental decision support tools, electronic spreadsheet implementation of the proposed method using the ubiquitous Excel environment is presented. In this way, the funding/solution space is made accessible and transparent to a breadth of NRC project reviewers and analysts seeking or analyzing funding options under a variety of funding/decision criteria.

In the proposed method without loss of generality, project features are designated as Category 1 (must be funded in the view of the evaluator) or as Category 2. The latter are features that the evaluator would like to examine under funding scenarios of inclusion and exclusion. If it fits the reviewer's interest, Category 2 may include all funding features. The following applies in the proposed method. Any Category 2 feature within any project may be unbundled (excluded) without prejudice to the project or its other features. Category 2 features are either fully funded in the requested amounts or fully omitted in all projects under consideration. Once Category 1 features are set, the allocation problem reduces to examination of funding/not Category 2 features in all possible combinations. Let J refer to the number of Category 2 features under funding consideration and $j = 1,\ldots,J$ the index distinguishing them. There are 2^J possible funding scenarios referenced by $v = 0,1,\ldots,2^J\text{-}1$ where $v = 0$ denotes the null funding scenario. The cost of scenario $v = 0$ is the totality of Category 1 feature costs.

An important aspect of the method is converting scenario references $v = 0,1,\ldots, 2^J\text{-}1$ to binary 0/1 forms that are indicative of all possible combinations of excluded and included Category 2 features. The conversion is explained with an example. Suppose an investigation will examine all possible funding scenarios among five (=J) Category 2 features. There are $2^5 = 32$ possible funding scenarios. Let $v = 0, 1, 2, 3, \ldots, 31$ denote the scenarios and the strings 00000, 00001, 00010, 00011, …, 11111 their respective binary conversions. The parameter J of the funding situation determines the length of each string. Let the rightmost 0/1 character of any string $e_5e_4e_3e_2e_1$ be referenced as e_1 and e_j be the 0/1 character in the jth (=1,…,4) position to the left of e_1. Let the e_j character 0(1) in any string denote the funding exclusion (inclusion) of Category 2 feature j (=1,…,5) in scenario v. To illustrate, scenario $v = 7$ would be converted to the binary string 00111 denoting, reading right to left, the funding of Category 2 features 1, 2, and 3 and the exclusion of features 4 and 5. In this manner, each of thirty-two possible funding scenarios is uniquely enumerated in an orderly fashion. The Excel function =dec2bin(v,J) converts the scenario reference v to binary form, Winston (2014) for discussion of this Excel function and Ipsilandis (2008).

Converting $v = 0,1,\ldots,2^J$ to binary 0/1 forms mimics the process of generating all possible funding scenarios by adding each j (=1,…,J) one