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APPLICATION OF OPERATIONAL RESEARCH METHODOLOGY FOR CLIMATE CHANGE MITIGATION POLICIES

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Abstract: The article deals with possibilities to apply Operational Research methodology in setting climate change mitigation policies in Lithuania. The most research subjects within Operational Research concentrate on decision making focusing on decision aiding tools such as Multi Criteria Decision Analysis, Group Decision Support Systems, Sustainability Appraisal, Life Cycle Assessment, Technology Assessment and Foresight, Logistic tools etc. Most of the research carried out in Operational Research focuses on the problem handling phases such as constructing scenarios, evaluating scenarios and suggesting interventions. Therefore before suggesting interventions and taking decisions it is necessary to evaluate how the phenomena and actors are related. Climate change is a complex societal phenomenon and climate change mitigation policies have impact on all society members and involve many actors and players in the field. The aim of the article is to apply Operational Research in setting climate change mitigation policies in Lithuania. The main tasks are to define the phases in problem handling process, the main actors and their responsibilities and tools for selecting the best solutions.

Keywords: Operational Research Method, climate change mitigation.

Introduction

Climate change is a complex societal phenomenon and climate change mitigation policies have impact on all society members and involve many actors and players in the field therefore the policy makers need to select the best climate change mitigation tool based on several criteria encompassing economic, social and environmental one and take into account public preferences. The Operational Research can be applied to handle complex societal problems such like climate change as a whole. The COMPRAM and other communication models can be successfully applied for dealing with climate change problem.

There are several GHG mitigation tools applied all in Lithuania and all over the world: command and control tools, carbon and energy taxes, GHG emission trading schemes, green tradable certificates, subsidies given to either producers or consumers of renewable energy, price or quantity based measures, voluntary agreements etc. In selecting the best instruments for climate change mitigation it is necessary to find a solution that gives the best outcome in terms of sustainability for all society members (Streimikiene, 2003; 2004). As the choice of the instrument will require some trade-offs among these sustainability criteria and involve preferences of various actors the several stages are necessary in this problem handling including various knowledge, tools and methods such as Multi Criteria Decision Analysis, Strategic Impact Assessment, Sustainability Appraisal, Life Cycle Assessment, Technology Assessment and Foresight, Logistic tools etc. The Multicriteria decision aiding tools provide decision makers to effectively handle complex decision situation such as climate change mitigation tools selection in which the level of conflict between criteria is such that intuitive solutions can't be satisfactory. A useful tool to compare the climate change mitigation policy instruments based on society preferences is provided by the conjoint choice analysis techniques.

The aim of the article is to apply Operational Research in handling of climate change mitigation problems in Lithuania. The main tasks are:

- To define the phases in climate change mitigation problem handling process;
- To identify the main actors and their responsibilities in climate change problem handling processes;
- To propose tools for climate change problem handling in Lithuania.

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The methods used: review of scientific literature on operational research , multiple criteria decision analysis and generalization of the main findings, application of pilot conjoint choice experiment for selection of climate change mitigation tools in electricity sector of Lithuania.

1. Operational research in climate change problems handling

Complex societal problems occur in each society all over the world. It is often uncertain when the problem started and what started the problem. It is uncertain what the problem looks like, where the problem leads to where it ends. The knowledge and data of the problem is usually missing or is in contradiction with each other. Especially when the problem is global like climate change many economies, nations, cultures, traditions of problems handling are involved making the problem handling process even more complex. The recent debates in the 13th Conference of Parties to UNFCCC in Bali indicated the complexity of climate change problem handling and hard process on negotiations towards new post-Kyoto climate change mitigation commitments and actions.

Complex societal problems have great impact on society. There are many people and actors involved in this process. Actors like decision makers, local and central governments, large and small private companies, international organizations and financial institutions. Each actor has his own view of the problem and likes to reach his own goal and has emotions and interests towards the problem. The group of actors involved in the process is sometimes changing during the problems handling process. The climate change problem handling process includes some knowledge, often lack of knowledge or uncertain knowledge, and the power, interests and emotions of the different actors involved in the process. Handling of climate change problem needs a long term integral approach. Integral with regards to reflection on the causes of the climate change problem, integral interventions of all aspects of the problem, as well as integral implementation of climate change mitigation and adaptation to climate change measures. There are also tendencies to privatize the benefits of the problems and to socialize the costs (De Tombe, 2002). The climate change problem is politically vulnerable. This limits the influence of scientists in this field. Scientists can indicate what is the best way to handle a complex societal problem, how to deal with uncertainties and how to handle the problem optimal in the interest of the general public however it is up to the politicians to decide on interventions. In real life complex problems are often not handling optimally. In handling these problems one tends to jump directly to discussing solutions without taking time exploring the problem. The problems are often handled in Lithuania as an incidence or implementation of EU directives or other regulations instead of structurally handling the causes of the problem.

The main phases of climate change problem handling process should be: defining problem and changing the problem. The first phase consists of the following steps:

- Becoming aware of the problem, and forming a mental idea of the problem and forming mental idea of the problem;
- Extending the mental idea by hearing, thinking, reading, talking and asking questions about the problem;
- Putting the problem on the agenda and deciding to handle the problem;
- Forming a problem handling team and starting to analyze the problem;
- Gathering data, exchange knowledge and forming hypotheses about the problem;
- Formulating the conceptual model of the problem.

The second phase includes the following steps:

- Constructing the empirical model of desired goal;
- Defining the handling space;
- Constructing and evaluating scenarios;
- Suggesting interventions;
- Implementing interventions;
- Evaluating interventions.

Each phase is of the same importance and integrates with each other (De Tombe, 2002). Therefore the complex societal problem such as climate change should include all phases of problem handling process. Missing aspects in an early phase can give a larger negative effect in the problem handling process than in a later phase. In order to decrease the chances that some things are overseen, a fruitful method includes iteration in the problem handling process, by explicitly regarding former phases of the problem handling process again before finally considering the interventions.

An important issues is what scientific methods and what tools or which combination of methods and tools can support complex societal problems such as climate change in a certain phase of the problem handling process given the kind of problem, the kind of problem handlers, the skills of the facilitator, the actors, the cultural environment, the time and money available. And other very important issue is the effect of the method and tool for handling the problem. As complex societal problems are interdisciplinary problems, therefore involves many areas of different scientific disciplines such as politics, education, psychology, economics, environmental, technological and natural sciences. This means that integrated knowledge from different scientific fields is needed to handle these problems. This can be realized by inviting experts from different disciplines to discuss the problems and integrate knowledge from other fields into their knowledge. The multidisciplinary approach is also needed for developing methods for handling complex societal problems. In such way existing methods and tools can be implemented and special approaches can be developed (De Tombe, 2000).

Because of the impact of climate change and its mitigation policies on society and the costs involved these problems deserve to be handle in a more structured and transparent way. The COMPRAM method developed by D. De Tombe (1994) can be used to solve complex societal problems including climate change. The COMPRAM method emphasizes to define the problem before starting to discuss interventions. This method is based on idea that complex interdisciplinary societal problems should be handled cooperatively by teams of different composition guided by a problem owner and a facilitator. The knowledge for handling problem comes from different fields of research. Therefore climate change problems have to be analyzed and handled by a team of experts, each with knowledge of one of the fields involved. In democratic society the actors who are involved have a say in it and should be included in problem handling team. The COMPRAM communication model includes seven layers and six steps in problem handling: analysis and description of the problem by a team of neutral experts, analysis and description of problem by different team actors, finding of interventions by experts and actors together, anticipation of societal reactions, implementation of interventions and evaluation of stages. The layers represent different forms of languages (verbal, visual, mathematical) and different forms of problem handling (experience intuition, semantic, causal, system dynamic simulation) models.

2. COMPRAM model in climate change problem handling

The process of climate change problem handling in Lithuania by applying COMPRAM model can be described by the following steps, actors and methods involved. For the problem handling process several teams should be invited to analyze and discuss the problem and to find interventions. First a team of experts with knowledge of the different fields (economics, policy, technology, mathematics, psychology, sociology, climatology, environmental science etc.) of the climate change problem is invited. The team analyses and defines the problem, including the description of phenomena and actors involved. In the next step the actors (local governments, regional environmental authorities, NGOs, private companies, SMSs etc.) are invited to give their own view on the problem, each discussing the problem with their own team. In the third step the views of all teams are compared and discussion starts for finding interventions. In the fouth step these interventions are carefully related to see what the possible societal reactions are, in order to prevent obstruction. Then, in the fifth step the interventions after implemented and in the sixth step the interventions are evaluated. Each step should end with a report in which the decisions, knowledge, the doubts are carefully documented, as well as the persons who are involved in the decision.

During problem handling process in COMPRAM model knowledge, power, interests and emotions are involved and carefully addressed. The model helps the knowledge from one discipline to integrate into that of other disciplines. In the first step experts from different disciplines discuss together what the problem means for their discipline. For example the problems of climate change, adaptation and mitigation impacts can be directly translated by an economists what this means for agriculture sector, energy sector, industry and the whole economy etc. In step two actors are invited to give their view of the problem and to discuss with each other the solutions they want to support or prevent. Inn the third step the views of different actors and experts are confronted with each other and discussed. In order to have effect interventions should be implemented simultaneously on different levels of the problem, as well as on different aspects of it.

Solving climate change problem requires mitigation in all sectors of economy and adaptation measures in all components of environment including water, soil, atmosphere etc. It is very important to aware beforehand of the reaction of a society has on the intervention s in order to prevent obstructions. This

done in the fifth step. In the last step of COMPRAM method the interventions are implemented and evaluated. The method is based on on theoretical scientific notions from cognitive psychology, sociology, computer science and theories about group process. The method includes various aspects of socio-cybernetics, chaos theory and system theory. Many of ideas of this method have been implemented however in addressing climate change problem the all steps in problem handling proposed by COMPRAM approach are crucial and needs to be adequately addressed.

The COMPRAM method includes many existing methods such as literature search, simulation, gaming, experiments, data and policy analysis, multicriteria analysis and decision aiding tools, interviews, surveys etc. It also uses a group decision support system by which people may communicate (De Tombe, 1994). Sevel layers method applied in COMPRAM also enables to support the communication between the members of different teams having different knowledge and experience. The method emphasizes the knowledge, skills and improvisation of facilitator which has to decide based on his knowledge which sub methods and tools should be included, what experts should be invited, what expertise is necessary for handling the climate change problem. The facilitator should have enough knowledge about methods and tools to select the right support for particular moment in the problem handling process. This does not mean that a facilitator should be capable to use all these different methods and tool by himself. An additional skill needed for a facilitator is knowledge about group processes including motions and power differences. Much of this knowledge comes from the social science. Content knowledge about the problem of climate change is crucial for facilitator. The focal point on UNFCCC the country should be the best facilitator in the climate change problem handling process.

3. Multiply Criteria Decision analysis

Multiple Criteria Decision Analysis (MCDA) is aiming at providing a formal approach helping decision makers to effectively handle complex decision situations in which the level of conflict between criteria is such that intuitive solutions can not be satisfactory. MCDA is particularly suited if in addition to the conflict between criteria is significant ambiguity in measuring performances and/or in articulating preferences. MCDA aim at broadening the decision making perspective beyond the limits set by the market mechanism, while both rely on values attached by people with multiply points of view. In traditional. MCDA has undergone an extensive development during the last 30 years as it was for handling today's complex problems, in which the level of conflict between multiple evaluation criteria is such that intuitive solutions are not satisfactory. MCDA is not a tool for providing the right solution in a decision problem, since no such solution exists. The solution provided might be considered best only for the stakeholders who provided their values in the form of weighting factors, while other stakeholders values may indicate another alternative solution. Instead, it is an aid to decision-making that helps stakeholders organize available information, think on the consequences, explore their own wishes and tolerances and minimize the possibility for a post-decision disappointment (Hobbs, Meier, 2000).

The decision type based on MCDA method can be the following: choice, ranking, sorting and portfolio. Choice is the simplest decision – selecting the one alternative among several alternative options. Ranking – placing alternatives in a preference order for selecting those ranked at the highest places. Sorting – grouping alternatives into broad hierarchical categories, each one including a number of non-distinctive alternatives. Portfolio – the most complex decision, identifying the best combination of alternative actions by taking into account not only the alternatives individual characteristics but also their interactions and synergies. The weighting is necessary in MCDA for the assessing of importance of criteria in decision support. The weighting techniques are developed in the MCDA framework divided in two broad categories following the classification of MCDA methods: compensatory weighting techniques and non-compensatory ones. Non- compensatory weighting techniques include: direct point allocation or fixed point scoring techniques, ratio weighting techniques, resistance to change and analytical hierarchy process. Compensatory weighting techniques are: Trade-off method, Wing method, Smart method, MACBETH and Conjoint choice method.

4. Conjoint Choice analysis

The conjoint choice analysis can help investigating how policy makers trade-off the criteria when designing a climate change mitigation policy. In conjoint choice analysis techniques respondents are shown various alternative representations of a good, which are described by a set of attributes, and respondents are asked to choose the most preferred. These alternatives differ from one another in the levels

taken by two or more of attributes. The application of the conjoint choice technique may shed light on the relative importance of criteria in order to suggest the choice of the optimal policy instrument. Some criteria or attributes can be expressed in monetary units and some can't be measured and are quantitative therefore conjoint choice analysis helps to evaluate marginal costs of some criteria based on conjoint choice experiment. A simple application of the conjoint choice methodology can be the example of car selection on the market. When we buy a car we compare the levels taken by the attributes that describe them. Car can be described by several attributes some quantitative and some qualitative (price, make, number of doors, engine, the use of fuel, comfort etc.). During the process of selection we judge these criteria among each other and therefore evaluate qualitative criteria by making a choice. The aim of the article is to present the methodological framework for the application of conjoint choice analyses in selection of climate change mitigation instruments for Lithuania.

In typical conjoint choice survey, respondents are shown various alternative representations of a good, which are described by a set of attributes and are asked to choose the most preferred (Markandya, Longo 2005). The policy alternatives differ from one another in the levels taken by two or more attributes. This approach has the advantage of simulating real market situations where consumers face two or more goods characterized by similar attributes, but different levels of these attributes, and are asked to choose whether to buy one of the goods or none of them. Application of Conjoint choice analysis for the selection of climate change mitigation policies in Lithuania would allow the choice of the instruments based on how the instruments performs in terms of sustainability criteria. For sustainability criteria the main sustainable development targets can be used expressed in eco-efficiency indicators, impact on technological progress and social indicators, such as employment, income inequality etc (Streimikiene, 2000; 2005). During the conjoint choice experiment the respondents should be surveyed seeking to define their preferences for climate change mitigation tools selection.

Conclusions

1. Climate change is complex global societal problem. Many different economies, nations, cultures, traditions of problems handling are involved making the problem handling process very complex. The recent debates in the 13th Conference of Parties to UNFCCC in Bali indicated the complexity of climate change problem handling and hard process on negotiations towards new post-Kyoto climate change mitigation commitments and actions.
2. For the handling of climate change problem the operational research needs to be applied. The subject of operational research is methodology and development of tools to support decision making. Most of the research carried out in Operational research focuses on the problem handling phases. Climate change as one of the main biggest complex societal problems requires special attention and advanced methods in problem handling process.
3. COMPRAM method developed by D. DeTombe is based on theoretical scientific notions from cognitive psychology, sociology, computer science and theories about group processes and can be successfully applied for handling climate change problems including adaptation and mitigation measures in Lithuania. The COMPRAM method is based on idea that complex societal problems involves interdisciplinary knowledge, different power, various interests and emotions and includes seven layers and six steps communication model for problem handling allowing to integrate all necessary steps, actors and tools.
4. The multicriteria and conjoint choice analysis are useful tools which can be integrated in COMPAR framework for selecting the best climate change mitigation tool for Lithuania based on several criteria encompassing economic, social and environmental one.

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