

MULTI-CRITERIA DECISION MAKING – DEVELOPER VIEW: APPLICATIONS IN THAILAND

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Abstract:

Multi-Criteria Decision Making (MCDM) is an effective method which integrates the three fundamental areas: searching for solution, aggregation of preference and decision selection. MCDM applications are implemented in a variety of industries such as environment, tourism, social services...etc. This paper reviews MCDM and its applications in Thailand. Each case study is varied in its problem type and decision maker requirements.

Keywords:

Multi-Criteria Decision Making (MCDM); Thailand

1. Introduction

Multi-Criteria Decision Making (MCDM) is a well known method that deals with decision problems under the presence of many decision criteria. It has been applied to solve complicated problems in various disciplines [1, 2, 3]. For example, the application of MCDM in Turkey [4] has helped a buyer choosing the suitable mobile phone. Another example is in China, the reported MCDM application fulfilled the satisfaction of customers by helping them to select the suitable logistic service provider based on their requirements [5]. The implementation of MCDM is widely used. In the case of Thailand, MCDM has been seen as a method to achieve an efficient alternative. A variety of applications have been implemented in several sectors. In this paper, an overview of MCDM is described. Then, the application of MCDM in Thailand is revealed and, finally, and conclusion is presented.

2. Multi-Criteria Decision Making (MCDM)

Multi Criteria Decision Making is an approach which helps the decision maker for identifying and choosing alternatives based on the values and preferences of the decision makers [6]. This approach is viewed as the intersection of three fundamental areas: searching for solution,

aggregation of preference and decision selection. The steps of developing a MCDM application differ in the way of information on alternatives, performance, criteria and relative significance that is elicited, specified and analyzed. However, MCDM process described below is similar and applicable for many approaches.

1. Defining the decision problem, context, and the stakeholders involved.
2. Identifying alternatives.
3. Finding criteria (what is important in making the decision).
4. Quantifying the importance of the criteria (weights).
5. Calculating the performance of the alternatives on the criteria (measures or subjective scores).
6. Ranking the alternatives or identifying the best alternative.
7. Examine, verifying and documenting the decision.

There are two general types of MCDM problem: a problem with a finite number of alternatives and a problem with an infinite number of alternatives. The problem which is associated with selection and assessment is grouped in the first type. The second type involves in problem on design whose value of the attribute is in the term of range [7]. Finding the criteria is important. All stakeholders who are related to the decision have to be identified. All information will be gathering and get ready to be the input of MCDM methods. Some of MCDM methods are shown in Table 1 [6,8]. The collection of information is lined up. The developer has to choose the MCDM method based on the line up information. In such a case, two or more methods seem to go along with this information, the developer has to employ all of them. The method with high accuracy is used to implement in the application. However, the application can be implemented by using two or more methods depending on the nature of information in the problem. MCDM problems may not always have a certain or unique solution [9],

particularly, in the interactive application. Solution of MCDM problem can be changed due to the update of information on each criteria.

TABLE 1. EXAMPL OF MCDM METHODS

MCDM methods	Type of information required on values of decision makers
Dominance methods	No explicit value judgements required
Maximin and minimax	Value judgement concerning the levels of risk particularly toward negative
Maximax	Value judgement concerning the levels of risk particularly toward positive
Conjunctive or disjunctive methods	Value judgments about the importance of needs to satisfy those needs
Lexicographic or elimination by aspect	Comparative value judgements on importance of attribute of alternatives acceptability. Elimination requires the judgement of only acceptability.
Weighting or scaling methods	Comparative value judgments about the importance of attributes with weights assigned.
Mathematical programming models	Value judgments about the importance of an over-all objective and the development of weights proportional to the relative value of unit changes in the value function.

The application of MCDM can be categorized into twelve areas as follow [10]:

- Transportation and Logistics ,
- Business and Financial Management,
- Managerial and Strategic Planning,
- Project Management and Evaluation ,
- Manufacturing and Assembly,
- Environment Management,
- Water Management,
- Energy Management,
- Agricultural and Forestry Management,
- Social service,
- Military Service.
- Other Topics covered the papers published in several fields: Chemistry, Sport, Physics and so on.

The application of MCDM normally involves in helping decision maker to select, rank and evaluate the alternatives of each problem. Some of the application have already been showed in Section 1. Next will be some examples of MCDM applications in Thailand.

3. MCDM Applications in Thailand

MCDM has been applied to a several areas in Thailand. Most of its applications are used in selecting the appropriate alternatives and ranking the alternatives. Examples are shown below:

- In Uttradit province, the happiness in the community has been evaluated by MCDM [11]. Several criteria, e.g. characteristic of community, the household salary, environment status and etc. were investigated. Result is shown in the format of map and detail of each attribute. Local officers could see the rank of happiness and the community where attention is required. It also helps the local officers to plan for the following year's development.
- MCDM helps local officer to adjust the appropriate policy for managing waste water in Pattaya [12]. Pattaya is an attractive city with a high demand of water usage. To prevent the situation of water shortage, water reuse is a significant method. MCDM is implemented in order to help in generating an effective policy for this matter.
- To consider the deployment of the hydropower project along the Ping river basin [13]. There are a variety of criteria such as e.g. electricity generation, engineering and economics, socio-economics, etc. MCDM helped in ranking the hydropower types. The officers used the results to decide the appropriate policy for particular hydropower type.
- In order to generate the freight logistic hubs [14], MCDM is iraplemented. The provinces which locate along the line North-South are ranked based on location, trade volume, logistic service provider and infrastructure.
- Using MCDM to zone the conservative forest in Nong Meg-Nong Hee forest, Maha Sarakham Province [15]. The criteria in this application consists of both local ecology issues and public participant indicators. The divided zone has been successful organized without any conflict with the community.
- A water management model [16] has been created in order to solve the conflict between two villages in the North. One of them is located near the water source. Another is nearby the river mouth. This water management model gives the list of appropriate crops for these two villages. With display in the simulation program, the value obtained by each stakeholder can be determined.
- An advice system for growing the energy crop [17] - The system implemented in Kanchanaburi provided a list of energy crops which are suitable for the particular area. 1976 FAO framework on crop plantation was applied as

the criteria.

- Pollution indicator [18] – MCDM has been applied to measure the performance of the environment in Bangkok.
- Wind turbine site selection [19] – Information of five provinces adjacent to the Gulf of Thailand was investigated. Integrating MCDM provided the ranking list for the wind turbine site.
- Identify the potential of ecotourism in Surat Thani [20] – An integrated application between MCDM and Geographic Information System (GIS) reveals the potential of each ecotourism site in this province.

According to the above examples, the implementation of MCDM in Thailand has been successful. Each application provided meaningful alternatives for its own problem. Decision makers can use MCDM applications for planning, selecting and managing. However, when community issues arise, the application may also involve people in the community. When the criteria of MCDM is related to people's opinion, the communication between developer/decision maker and community have to be clarified [11] [16] [17]. Otherwise, the result of MCDM would be inaccurate and all the processes has to be repeated again. Knowledge transfer is also compulsory before the project started [12] [15] [16]. The community should understand the model clearly in order to prevent any conflict.

4. Conclusions

The application of MCDM has broad usages due to the property of flexibility. It can be implemented in a variety of areas. However, many techniques of MCDM have designed for different problem. The appropriate techniques for a problem has to be considered before the implementation. Examples in Section 3 reveal the advantages of MCDM in Thailand. In addition, developer/ decision maker should be aware of community issues which might become the obstacle in the project.

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