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MADM AND FUTURES STUDIES; A NECESSITY

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Abstract. Multiple Attribute Decision Making (MADM) has been developing in different methods, perspectives and frameworks since introducing step. Futures Studies as a specialized framework and methodology has introduced newer and has been always in developing phase too. MADM as a part of Multiple Criteria Decision Making is known as multi-disciplinary approach, framework and methodology. Nowadays, Futures Studies is also known as multi-disciplinary approach too. Basically, MADM is structured for a stable environment while most decisions need to be made, dynamically. Time is so much important especially in the new century in comparison with the past. Decisions making about future are usually so complicated and MADM can be helpful in that process. Importance of making future based decisions is undeniable in trying to answer to decision needs. This research will present a comprehensive review on the literature of MADM and new orientations in considering future in MADM models and necessity of them will be checked also carefully. Eventually, importance of seeing both MADM and Futures Studies together as a unit model will be discussed in this study.

Keywords: Multiple Attribute Decision Making (MADM), Multiple Criteria Decision Making (MCDM), Futures Studies, MADM based Scenarios, Dynamic MADM (DMADM), Prospective MADM (PMADM).

JEL Classification: C02; C44; C61.

1. Introduction

Multiple Attribute Decision Making (MADM) and Multi-objective Decision Making (MODM) are sub-categories of Multi-Criteria Decision Making (MCDM) (Liou, Tzeng 2012; Zavadskas *et al.* 2014). MADM is a widespread methodology in decision making about different topics and fields. Nowadays, decision making with MADM methods is so common in so many vital issues like: economics, society, management science and etc (Chai *et al.* 2013; Wang *et al.* 2013; Aguezzoul 2014; Mardani *et al.* 2015; Hashemkhani Zolfani *et al.* 2016a). Today, MADM can be considered as a multi-disciplinary methodology in process of decision making and problem solving (Ishizaka, Labib 2011; Behzadian *et al.* 2012; Aguezzoul 2014; Mardani *et al.* 2015).

From introducing SAW (McCrimon 1968) till now so many methods has been developed in MADM field as sub-field of MCDM such as:

AHP (Saaty 1980), TOPSIS (Hwang, Yoon 1981), ELECTRE (Roy 1968), PROMETHEE (Brans *et al.* 1984), MACBETH (Bana e Costa, Vansnick 1994), COPRAS (Zavadskas, Kaklauskas 1996), VIKOR (Opricovic 1998), MOORA (Brauers, Zavadskas 2006), ARAS (Zavadskas, Turskis 2010), SWARA (Keršulienė *et al.* 2010), WASPAS (Zavadskas *et al.* 2012), FARE (Ginevicius 2011), MULTIMOORA (Brauers, Zavadskas 2010), BWM (Rezaei 2015) and EDAS (Keshavarz Ghorabaee *et al.* 2015).

Decision making about dynamic situations, challenges and policies has been a common act since previous century in all around the world. During the previous decade dynamic perspective has added in different ways into the MADM structure and methodology (Xu 2008; Lou *et al.* 2010; Campanella, Ribeiro 2011; Trutnevyte *et al.* 2012; Zhang 2012; Durbach, Stewart 2012a; Hashemkhani Zolfani *et al.* 2013; Tadic *et al.* 2014; Gonzalez-Prida *et al.* 2014; Jassbi *et al.* 2014).

Usually dynamic situation for decision making is related to the future topics. It means dynamic situation is critical and vital for actions and should be linked to the future decision and policy making.

Recently some researchers interested in considering future in their decision models in different ways but primarily. Definition of dynamic MADM model has defined in recent studies and different dimensions.

This research is going to criticize MADM history and structure from the base up to now. The main aim is an investigation on MADM framework and methodology to clarify and identify relationship between MADM and futures studies. Decision making is on more dynamic road and MADM can't be considered as an exception. All new trends in MADM will be checked in this study.

2. Latest contributions related to the MADM and Future Studies

This part is designed in two sections includes:
1. All achievements in classic MADM structure,
2. All contributions on MADM framework and future studies' methodologies.

2.1. All achievements in classic MADM structure

Dynamic decision making based on MADM structure has been developing since from 1980s. Ozernoy (1988) gave some information about application of MCDM methods in R&D Project selection in USSR, 1971–1986. That research has shown future thinking about developing phase since about half of a century and based on MCDM framework.

Leong (1998) worked specifically on responding to the dynamic needs in MADM structure. Time and uncertainty have considered as different positions and situations in the model. Different answers will be ready for each time and situation.

Salo *et al.* (2003) presented new perspective in technology foresight about R&D projects' evaluation. MADM methods applied to this process and MADM has considered as a core for projects' evaluation. The study just considered a probable future as the base and nothing new as the methodology was in that.

Interval data considered as the weight of criteria, dynamically. Xu (2008) considered different relative importance for criteria using interval data in different time periods. Different answers for each decision making problem will be generated based on this perspective which can't be a comprehensive structure, eventually.

Lou *et al.* (2010) applied time series analysis and historic data due to need of considering MADM, dynamically. The research doesn't have any direct relation to the future studies but prediction could be considered as a good start in futures studies' area.

A primary model for dynamic MADM presented based on historic data from past experiences and with current data. Based on Campanella and Ribeiro (2011) the model had something new but future didn't see in that as a dynamic decision making model.

Zhang (2012) presented applicable and useful idea about dynamic MADM model which the model could consider different periods of time. Three different time periods considered and this perspective can be considered as a primary model to future needs of decision making.

Considering foresight perspective was another contribution into MADM model. From the base a research decision making problem can be structured based on foresight perspective. Hashemkhani Zolfani *et al.* (2013) consider this perspective in a locating topic about shopping mall site selection.

Wang *et al.* (2013) considered grey numbers in evaluating MADM model in a time period. Considering vagueness based on grey interval numbers was contribution of the study.

Gonzalez-Prida *et al.* (2014) presented a new dynamic model for AHP (DAHP). Similarly to Campanella and Ribeiro (2011) past data considered with current data and also considered that for AHP method. Although the research didn't consider future but had something new as a contribution to the literature.

Ondrus *et al.* (2015) developed based on Salo *et al.* (2003) study. This research applied computer calculations and visualization to the previous structure in project selection as a part of technology foresight process. Another innovation of this research was this ability for each expert to develop his/her criteria for the model.

The latest model for DMADM has presented by Jassbi *et al.* (2014) in generating a new model for MADM. Past, current and prediction as future information have considered in that new DMADM model and as the main contribution. Although foresight and futures studies weren't in the model directly, future considered somehow in the structure.

2.2. All contributions on MADM framework and future studies' methodologies

Supriyasilp *et al.* (2009) used MCDM structure in evaluating two different scenarios for hydropower development priorities. Each scenario was consid-

ered separately in the evaluation process. Browne *et al.* (2010) applied MCDM framework for evaluating scenarios. That process considered to identify the best scenario.

Durbach and Stewart (2012b) analyzed the scenarios with MADM framework with fuzzy numbers. That research tried to consider uncertainties in the decision making models. Petit and Fraser (2012) worked on energy section. Different scenarios were evaluated based on AHP method in that study.

Ribeiro *et al.* (2013) evaluated future scenarios based on MCDA model. They just analyzed the scenarios based on a set of criteria. Optimization also was used in the study in generating scenarios. Marzouk *et al.* (2013) considered different scenarios as the alternatives for evaluating proposed projects. The final evaluation was planned based on MADM framework.

Ram and Montibeller (2013) worked on a new concept entitled Scenario-based MCDA methods for robust choice. Each scenario analyzed based on MCDM framework. Stewart *et al.* 2013 introduced a new concept in evaluating scenarios based on MCDM methods and called meta-criteria which work as a combination between scenarios and primary criteria.

Chung and Kim (2014) used fuzzy TOPSIS for evaluating future scenarios about climate change. Also results of TOPSIS and fuzzy TOPSIS compared to each other.

Sawicka and Zack (2014) applied ELECTRE III as a stochastic model in evaluating scenarios in a new approach. All scenarios ranked and assessed based on the stochastic MADM method. Štreimikienė *et al.* (2016) assessed different scenarios about generation of technologies in electricity section with a hybrid MADM model, AHP-ARAS, as the methodology of the research. All five scenarios were evaluated based on the hybrid MADM method.

3. Comments on MADM and future studies

Due to latest research articles about dynamic MADM (DMADM) it can be concluded that decision making about future issues is still vague and complicated. Classic structure of MADM models couldn't create a good answer to the needs and research questions about future. Considering decision environment as a stable situation for the future is completely a wrong perspective. Recently, two new perspectives have added to the MADM literature.

Hashemkhani Zolfani *et al.* (2016a) presented a new combination between two multi-disciplinary research fields, Futures Studies and MADM. This research presented a new perspective in decision making with MADM about the future. In opposite side of scenarios based MCDM, this research has designed when different future scenarios can shape our decision models in practice. For each scenario one MADM model created in that study and final decision about the future made based most affective criterion and applicable alternative. This study is shown that hybrid models based future studies' methodologies and MADM structures can be helpful as a new inter-disciplinary framework.

Hashemkhani Zolfani *et al.* (2016b) presented a new perspective and sub-field in MADM framework. Dynamic MADM (DMADM) has been developing during the last decade woth different approaches and perspectives. This study is the latest contribution about considering future in multiple attribute decision models. Prospective MADM (PMADM) is focused on the decision making based on future aspects of issues and their dimensions. Due to this research MADM can be developed for future perspectives. For the first step, limiters have introduced as a new part which can be added to classis structure of MADM structure. One of classic MADM methods, WASPAS, has developed as PWASPAS based on new perspective, adding limiters, to show this new contribution in practice. This model of PWASPAS also can be developed in the future research and in the new probable contributions of PMADM model.

PMADM model can be developed in two key phases: 1. developing classic dimensions such as relative importance of criteria and weighting those. 2. Adding other new sections as new parts of MADM model such as what introduced in first PMADM model, limiters, in practice. It can be predicted these approaches will be developed in the near future in helping decision making about future and with multiple attribute decision structures.

4. Future of MADM and future studies

As mentioned above, two parts can be considered as intersection of MADM and Futures Studies in general point of view. These two parts include: 1. MADM and futures studies methods, 2. Prospective MADM as a new specialized sub-field.

4.1. MADM and future studies methods

MADM has been applying in different ways with scenarios such as: Scenarios based MADM and MADM based scenarios. But this structure is ac-

ceptable and applicable for other Futures Studies methods and methodologies. For example, MADM can be used in Backcasting in terms of evaluating different options and priorities and also in different time periods. Other methodologies also are useful for research about the future. For other instance, game theory is helpful about decision making process for the future. Hashemkhani Zolfani and Seyed Agha Banihashemi (2014), and Hashemkhani Zolfani *et al.* (2015) applied MADM methods in decision making process with game theory in practice. MADM can be applied for supporting game theory in future decision making and different ways and frameworks in it. These kinds of intersections can be developed more in the near future. With this idea, results can be considered more reliable from both MADM and Futures Studies perspectives.

4.2. Prospective MADM as a new specialized sub-field

Prospective MADM (Hashemkhani Zolfani *et al.* 2016b) has introduced lately with a completely new idea about applying future thinking in the decision making process. It can be considered just what PMADM is and how does it work presented in a research study. A new element added to the classic form of MADM structure and this element shows that MADM framework can be developed more in dynamic forms.

Decision making for the future is so complicated and it is hard to do it just with previous experiences in decision making frameworks. Dynamic MADM couldn't answer to all these needs up to now and now it can be seen PMADM has something new with appropriate ability to answer to the decision making process needs.

PMADM haven't limited in methodology and other elements can be developed in different perspectives. Classic elements of MADM also can be advanced with different frameworks and structures. With developing futures studies as a more specialized multi-disciplinary and inter-disciplinary field, developing methodologies for this new area it seems inevitable. There are so many postgraduate fields for futures studies in USA, Finland, Taiwan, Australia, Iran and etc.

5. Conclusion

Futures Studies and foresight have been developing in the new century more than all the history. Methods have been emerging in Futures Studies since about 60 years ago. Nowadays, methods are still in developing phase and can be considered as methodologies. So many methodologies and methods have recognized for Futures Studies and foresight such as: Scenario Planning, Casual Layered Analysis (CLA), Backcasting and etc. As a field, Futures Studies still has a scientific capacity to be developed more and more. Also other methods and methodologies are in developing steps to be equipped by future perspective and structures.

In general, Multiple Criteria Decision Making (MCDM) is a useful methodology in Futures Studies and actions as a foresight system. Due to needs this framework has been developing in the new century and because of that so many research articles have focused on this topic. MADM as a major part of MCDM is more related to future decisions in practice and in comparison with MODM. Dynamic MADM (DMADM) has been developing in latest years but couldn't still answer to future needs in decision making process in practice and action.

The latest contributions about applying future trends in decision making process presented as MADM based scenarios and Prospective MADM (PMADM). Based on these two new contributions, intersections of MADM and Futures Studies have separated in two sections: MADM and futures studies methods, 2. Prospective MADM as a new specialized sub-field. From now to the next decade Futures Studies and MADM will be in cooperating through these two categories. PMADM, especially, is in the first step and can be continued in different methods, perspectives and frameworks.

As a conclusion, relation between MADM and Futures Studies is inevitable. MADM couldn't save its position in the scientific societies and scholars without this new trend. Nowadays, decision making become more and more complicated. Decision making methodologies and methods should be directed to this new trend. It can be predicted MADM and PMADM can be linked as a methodology in Futures Studies field in the near future.

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