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Research Paper

Futurology of Multi-Criteria Decision Making Techniques Using Philosophical Assumptions of Paradigms in Scenario Writing

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Abstract **There are many opportunities and threats in the decision-making environment for managers, and an organization must use research and information systems to change, monitor, and anticipate this environment. Futurism reflects how tomorrow reality gives birth to tomorrow's reality is. The purpose of this research; Analyzing the role of futures studies in the existing patterns of critical factors of multi-criteria decision-making techniques in operations research using the philosophical assumptions of the classical and critical paradigms and finally determining the appropriate strategy based on these components, to increase success and life expectancy. The present study intends to formulate exploratory scenarios of this knowledge by using the critical uncertainty approach. To develop credible scenarios of knowledge of decision techniques, the opinions of 15 experts in this field were collected using the fuzzy Delphi approach and through the critical uncertainty questionnaire. After extracting the most important uncertainties, plausible scenarios of decision-making techniques were determined with the help of experts. According to the results obtained from the opinion of experts from the critical uncertainty questionnaire, four research uncertainties were identified, identified and the scenario design criteria were used. Each of the four cases, which includes low attention to social issues versus high**

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attention to social issues, low attention to ethical models versus high attention to ethical models, low attention to soft approaches versus high attention to soft approaches, Low attention to complex issues versus high attention to complex issues indicates a specific dual situation in the future. Each of these dual situations indicates uncertainty about the future of multi-criteria decision making. Based on these uncertainties, three scenarios were identified. These scenarios include Achilles heel, phoenix, and heel. Also, semi-structured interviews with the theme analysis approach were used, and the philosophy of past and future approaches in this field was reviewed and critiqued.

Keywords *Futures Research; Multi-Criteria Decision Making; Paradigm; Scenario Writing*

Introduction

Some researchers believe that the future cannot be studied in principle because what we have about the future is based on a series of hypotheses that have no definite guarantee of occurrence, and our knowledge of the future is only a few speculations that provide a scientifically sound framework. They are not available for scientific research. This group considers futurology to be, to its fullest extent, only a prediction of the future. Because there is no certainty in the prediction findings, futures studies are not considered valid enough, and this has led futurists to respond to the followers of this thinking in the scientific community, to carefully carry out their futuristic activities. How much more to add to the belief that futurology, like other sciences, has passed through the corridors of evolution and has reached an evolved stage that can no longer be considered as futurism, which is a passive approach in dealing with It is with the future, but today futurology tries to construct it with an active approach to the future, which is a more evolved level than mere and absolute prediction (Malekifar, 2016). In recent years, the limitations of multi-criteria decision-making methods have become apparent to all. These limitations are not related to the accuracy and validity of the techniques used,

but rather to the applicability of these quantitative techniques to some very complex and specific issues (Carlsson, 2017). Decision models have undergone many changes since its inception. The study of the future of multi-criteria decision making techniques and the need for planning for it has received less attention in the literature, and the scattered activities lack the necessary methodology (Azar, 2012). Therefore, the present study examines the differences and gaps between research issues and answers in soft and hard operations by studying the future research of multi-criteria decision making techniques. In the importance of decision making, it should be stated that decision making includes the correct expression of goals, determining different and possible solutions, evaluating their feasibility, evaluating the consequences and results of implementing each solution and finally selecting and implementing it (Cristóbal, 2019). The quality of management is essentially a function of the quality of decision making. In most cases, decisions are made when the decision-maker is satisfied and satisfied when the decision is based on several quantitative or qualitative criteria. In multi-criteria decision-making methods, instead of using one measure of optimality, several criteria are used (Mehregan, 2009). The future cannot be said with certainty, but man can influence the future. In the meantime, knowledge is born that tries to both control the changes and prepare the society for these changes by anticipating the factors influencing the future changes in a dual way. Over the past two decades, foresight has become one of the most important tools for policymakers in all areas to assist policy and decision making. In Europe, the United States and Japan, this knowledge has been widely used to seek the opinions of various experts, bring views closer to each other and build consensus, and based on the knowledge and awareness gained from these futurists, determine perspectives and policies. they do. Futurology is a systematic effort to examine the long-term future of science, technology,

the environment, and society in order to identify emerging phenomena and areas of research that have the greatest social and economic benefits (Rosenhead, 2006). Therefore, in today's world, futurism and foresight is a necessity. With a brief look at the role of the future in design and decision making, we can understand the importance of futures research in operations by looking at multi-criteria decision making techniques as a decision science in management. The longer the time horizon of the process, the greater the number of decision-making issues in different time periods, and the field has developed methods to solve each of these issues (Ram rezmirez & Wilkinson,2016). This article examines the multi-criteria decision-making strategies that make up the science of operations research and will be a good introduction to the development of a normative scenario in this field.

Literature Review

Futurology is a multidisciplinary and transdisciplinary study that aims to identify the possible or desirable state of a society in the future. Futurism is a process that predicts several different events in the future. In this definition, the term prediction is used as a proposition that indicates the relative probability of the occurrence of certain general processes or a series of events (Altiok, 2015). Futurism is part of the design science and a new form of community design and technology. Futurism: Expressing the future consequences of current decisions, predicting future issues and problems, as well as designing alternative solutions so that society ultimately has more options and can choose appropriate and ethical options (Bell, 2018). Due to the political, cultural and historical conditions of different regions, different traditions in futures studies emerged over time. Slater lists the following four traditions in futurism:

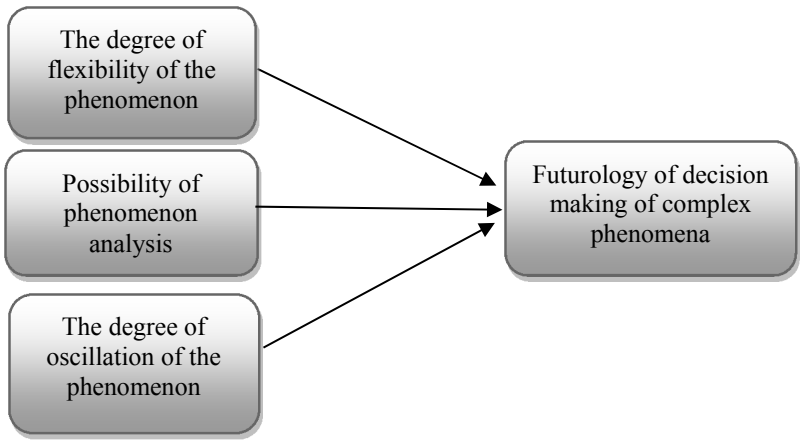
- The experimental tradition that developed most in the United States.

- A tradition whose methods were mostly social and cultural in origin and originated mainly in Europe and eventually became a critical tradition.
- An international and multicultural tradition that has spread more than any other tradition and is still developing.
- Works on the future of integrals that have emerged with the work of Ken Wilber and colleagues around the world, and in a way it can be considered the evolution of aforementioned traditions (Slaughter, 2013).

A number of European pioneers considered its social, cultural, and political aspects and began to explore and design the concepts and themes of urban society, education, politics, and the like. Their work led to greater breadth and depth of research into the future. However, they were less preoccupied with new technologies and more concerned with the concept of a good life combined with social innovation and its introduction to society as a whole (Groff, 2015).

Figure 1

Factors Affecting Futuristic Decision Making of Complex Phenomena (Slaughter, 2013)



Because they measure the success of each phenomenon in its work, they also evaluate the success of futures research in decision-making in terms of achieving the goals of the decisions made. Goode, a French futurist, believes that the success rate of a futurism project or futuristic thinking can be measured by the quality of group reflection and the adaptation of project analyzes and conclusions. In fact, futures studies should be retrospective and reach the present, find trends in this field, and then, using flexible and hybrid theories, examine what the possible future will be for the field of decision making (Khazaei, 2015). Since the introduction of scenario planning, several definitions have been proposed by researchers, and the study of these definitions is very useful in order to create a mentality towards the research topic. The following table examines the various definitions of futurists about scenario planning.

Table 1

Scenario Planning Definitions (Kowalski, 2009)

Definition	Date	Author
A systematic way of imagining possible futures in which organizational decisions are made.	1995	Schumacher
A tool for futurist discussions that aims not to predict a program but to change the attitudes of its users.	1997	Degos
Scenario planning is one of the futuristic technologies used in the development of organizations that uses the remarkable capacity of human beings to imagine and learn from what is imagined.	1998	Bowden
Scenario planning is an effective futures research tool that enables planners to consider what is likely to happen and what is unlikely to happen.	1998	Alexander
Creates a narrative about the future as believable and planned as anyone can move forward.	2002	Tucker
is a collection of imaginative but believable and well-focused narratives about the future	2014	Kahan
is a scenario in simple language, a tool to show a future reality in order to illuminate the current activity with a view to the desired and probable future.	2017	Gadet

Critical science contributions to operations research decision-making techniques:

Critical approaches support the equal distribution of powers and opportunities, attention to human freedom, exclusion of restrictions, empowerment of participants, and rejection of domination. Critical theories are more normative than descriptive. Hard and soft methods usually describe the current situation and do not pay attention to criticism and change. Many experts believe that decision making is a tool to maintain the status quo (Ahmadi, 2014). Operations research is very important in creating legitimacy. Operations research with slogans such as "Leave the job to the expert", "We are all in the same boat, do not destroy it, do not damage it", helps to effectively deprive the masses of power. Operations research specialists seek to maintain the status quo by resorting to traditional rational models. During the 1980s, a new set of critical thinking methodologies emerged in British academic circles. This approach was a new breakthrough in UK system practice (Jakson, & Flood, 2016). Critical and liberating methodologies are opposed to hard and soft approaches, as if these approaches are also logical alternatives. The philosophy of this approach is based on the belief that social systems are oppressive and there is inequality within them (inequality between participants). The emergence of this paradigm is largely due to the work of Jackson and Robert Flood in England in the early 1980s. The main feature of these approaches is to empower the actors who participate in an activity. The critical system thinking paradigm provides the necessary philosophical underpinnings for this group's methodologies. The purpose of the critical paradigm is to provide a framework for methodologies that seek to influence areas in which the social and organizational worlds are considered oppressive and unequal. The critical paradigm calls into question the positivist view of the humanities. Critical experts in operations research also theorized in response to the positivist and functionalist nature of classical methods (Paucar-Cacers, 2010).

Table 2

Different Approaches to the Critical Paradigm (Jackson, 2013)

Current TSI	Current CHS	Aspects
Provide a meta-methodological framework for the conscious choice of methodologies, especially systemic methodologies	Provide a reasoning and thoughtful framework for liberating and thoughtful professional activity, regardless of the methodology used	The main methodological goal
A contingency approach for selecting and combining appropriate methodologies according to different problem situations	An argumentative approach to the importance of critique and explanation, as well as asking for criticism and explanation of other claims (claims that consider themselves valid and credible)	Basic idea: a critical approach
Systematic system methodologies: Classification of methodologies according to their assumptions about the situation of the problem. As a result, it will be possible to use a combination and inform them.	Inclusive borderline criticism, critical application of borderline judgments	The central concept of methodology
The unresolved problem of pluralism and methodology, how do the applied sciences justify the combined use of different approaches (hard, soft or critical)?	The unresolved problem of scientific reasoning and logic, how can the applied sciences justify the normative content of their claims to knowledge and rationality?	Major methodological issues
Choice of informative methodology	Critical Inclusive Discourse	The result of this approach to critical action

The purpose of critical methods in decision-making in short is: meaningful participation of all parties involved, attention to the centers of power and their ideologies, empowerment of disadvantaged people, revealing sources of inequality and discrimination, providing a platform for inclusive discussion and discourse In the organization, support for facilitator and democratic modeling in the organization. Thus, multi-criteria decision-making techniques have been influenced by critical approaches such as Marxism, the Frankfurt School ideas, and even poststructuralist ideas. Thus, it can be said that one of the basic features of multi-criteria decision-making techniques is its interdisciplinary nature, because this knowledge contributes to a wide range of sciences, including mathematics, natural sciences, psychology, social sciences and critical sciences. Has been affected (Godet, 2016). Of course, some do not include critical theories in science because they believe that these views are more normative and descriptive than descriptive. Habermas strongly rejects such a view and divides the sciences into three categories: natural, cultural, and transcendental. According to Habermas, the mission of science is not only to describe the current situation, but also science should have a liberating and enlightening aspect (Wallace, 2014). A comprehensive review of multi-criteria decision-making is paradigms of operational research Paradigms are a set of basic assumptions that guide various researches in a field. The basic assumptions of research paradigms in operations are ontology, epistemology, methodology. According to research studies, research paradigms in operations are: classical paradigm, critical realism paradigm, interpretive paradigm, normative paradigm, poststructuralist paradigm and The pragmatism paradigm is one of the methods of research in operations based on a particular paradigm and based on specific philosophical assumptions. For example, linear and dynamic programming is based on the classical paradigm. (Carlsson, 2017). The

interpretive paradigm includes a range of soft methods. Clear examples of critical realism can be seen in the system dynamics approach. Critical exploratory methodology is a method based on the normative paradigm. Local systemic intervention can also be considered as a poststructuralist approach. The method of inclusive systemic intervention can also be described as a pragmatic approach. In this research, the researcher seeks to address the philosophical assumptions of the classical paradigm and the critical realism paradigm. Table 3 shows the ontological, epistemological, and methodological assumptions of the classical paradigm. Many call this paradigm a hard or traditional approach. Some methods related to traditional or classical paradigms are: mathematical programming method, dynamic programming, queue models, discrete simulation. These models study the problems of the material and physical world and use quantitative and objective data for modeling (Westcombe, 2014). The main foundation of classical models is functionalism.These models seek to optimize and solve problems and use constraints, variables, and mathematical symbols to represent reality. The epistemological orientation of classical models is a tool with a technocratic approach (Wallace, 2014).

Table 3

Philosophical Assumptions of the Classical Paradigm (Westcombe, 2014)

More emphasis on the phenomena of the physical and material world	The worlds we face	Ontology
The reality is mostly non-translational. Emphasis on facts, variables and measurable processes and relationships between them	The nature of reality	
The real world works like a system and has specific goals.	The ratio of the real world to the world of systems	

There is a reality outside the mind of the researcher. There is a lot of emphasis on objectivity	The researcher's relationship with reality	
Most of the information and data required are quantitative. The source of knowledge is the observation and measurement of real and objective processes. Data collection strategies include observation, structured interviews, and questionnaires	Necessary information and source of knowledge	
Knowledge is objective and is obtained by studying real-world phenomena	The nature of knowledge	Epistemology
Instrumental orientation with a technocratic approach: Knowledge gives man the ability to discover and control the rules of the natural and social world	Epistemological orientation	
Naturalism, Mathematics and Functionalism	Theoretical foundation	
Technical interests	Epistemic interests	
Mechanical systems, models, equations of constraints, variables are the best way to represent reality	Representation forms	
The models are descriptive. Models examine existing realities objectively	The tone of the models	
Be logically related to the rules and be based on facts. The results and results of the model should be tested with real-world data. Matching reality is a measure of credibility. The most important criterion for the validity of such models is compliance with the object.	Credibility	Methodology
Analogy and induction	Modeling strategy	
Each of the classical methods is effective in different stages of intervention in the problems of the material and physical world.	Fit the problem review steps	
The methods are generally quantitative and have a mathematical and statistical nature	The nature of the methods	

Table 4 shows the ontological, epistemological, methodological assumptions of the critical realism paradigm. The critical realism approach is an objective approach that has both conceptual and normative elements.

Critical realism developed as a reaction to criticisms of empirical and naturalistic positions in the philosophy of science. The main contributions of critical realism are:

- The development of a new insight into "existence in the realm of ontology while relativism accepts knowledge (knowledge is a historical and social phenomenon) in epistemological realms.
- Defending the position of critical naturalism in science (Mingere, 2016).

In his later works, Baskar proposed exploratory critique as a way of reconnecting between facts and values, and Baskar developed the concept of dialectics as positive and negative interactions, and presence and absence. Critical realism has been influential in many disciplines, including geography, economics, organizational theory, sociology, international relations, and research methods in general. Bascar's starting point is specifically the debate against empiricism and positivism. Bascar takes an effective anti-positivist naturalistic approach. According to him, social objects can not be studied like the objects of natural sciences, but they can be studied as social objects and in scientific ways. The main purpose of critical realism was to provide a comprehensive and appropriate alternative to the positive approach and to pay particular attention to its view of causal laws as fixed connections. For Bascar, there is a difference between a causal law and a pattern of events. A fixed connection should refer to a theory that provides an explanation of the relationship between two events, that is, a theory that provides a concept or picture of effective mechanisms and structures (Blaskar, 2015). Experiences, events, and mechanisms. They form three overlapping realms of reality: the empirical realm, the real realm, and the real realm. The empirical realm includes experiences that are observable; The realm includes events that may or may not be observed; The real domain contains the structures and

mechanisms that produce these events. Bascar also added a critical element to his approach called the liberating element. In his view, the social sciences cannot be neutral in two ways. The social sciences require practical intervention in social life and logically involve value judgments (Bhaskar, 2015). Bascar emphasizes the existence of external reality to show that the knowledge gained can be both erroneous and modifiable. By distinguishing between translated and non-translated objects, Bascar claims the existence of an external reality and believes that knowledge of this reality has an erroneous nature. Therefore, according to Baskar, the main mission of science is to improve our interpretations of facts, not to find absolute truths. Science moves from some phenomena (or their absence) that have been observed or experienced to the logical analogy of some of the mechanisms or underlying structures that, if they existed, would causally create those phenomena. This approach is known as post-mining.

Table 4

Philosophical Assumptions of the Critical Realism Paradigm (Gilles, Donald, 2011).

More emphasis on the phenomena of the physical and material world and to some extent personal and social	The worlds we face	Ontology
Reality has both a translator and a non-translator aspect. Reality is: experiences that are observable; Events that may or may not be observed; The structures and mechanisms that produce these events.	The nature of reality	
The real world is not only very complex, but also layered in different areas. Social reality has individual, group, institutional and comprehensive levels		
The real world is systemic, but to understand it properly we must pay attention to basic causal arrangements and structures.	The ratio of the real world to the world of systems	

Reality is objective and exists outside the mind of the researcher.	The researcher's relationship with reality	
The structure and causal relationships between flows ideally with measurable, quantitative data, and mathematical relationships The source of knowledge is to observe and measure real-world processes along with judgments and attitudes. Data collection strategies include observation, structured interviews, and questionnaires. Quantifying is a value	Necessary information and source of knowledge	
Knowledge is the models derived from multi-layered reality and their re-explanation. Knowledge is erroneous and temporary. According to the epistemology of critical realism, to go beyond superficial manifestations to the hidden nature of things, it is necessary to be curious about beings and processes that are not observable or not easily seen.	The nature of knowledge	
Instrumental, understanding, and liberating orientation that enables man to understand and discover his world.	Epistemological orientation	Epistemology
This approach was inspired by Harry's writings on the philosophy of science in 1981, 1972, 1970, and 1961. Then two of his students, Bascar Wicket 323, expanded his work. In 1990, 1982, and 1978, Bascar's early work, like Harry, was related to the natural sciences, but both turned their attention to the development of realistic scientific principles in the social sciences. The writings of Bascar and Tilly in 1997 were hailed as a shocking and controversial statement about the use of this paradigm in social research.	Theoretical foundation	
Technical interests	Epistemic interests	
The models have descriptive, interpretive and somewhat explanatory tones. The description and	The tone of the models	Methodology

interpretation of apparent events requires an explanation of the underlying generating mechanisms and structures	
Use conceptual models, impact diagrams, causal diagrams and interactive software to represent reality	Representation forms
Human cognition, comprehensibility and liberation from social realities, results and achievements of models are correct if they increase our power in describing and interpreting apparent events and explaining the underlying causal structures.	Credibility
So mining	Modeling strategy
Critical realism methods are used in different stages of intervention.	Fit the problem review steps
The methods are generally quantitative and have a mathematical and statistical nature. Of course, sometimes these mathematical methods are combined with some qualitative methods such as SSM and cognitive mapping	The nature of the methods

Since in this research, the methods and issues of research decision-making techniques in operations will be examined and finally, in this field, future research will be done, so the research questions are:

- What are the main content issues of multi-criteria decision-making techniques over the past 35 years?
- What are the plausible scenarios for the decision-making methods of several criteria of research science in operations in relation to the issues of this science in the future?

Reseach Methodology

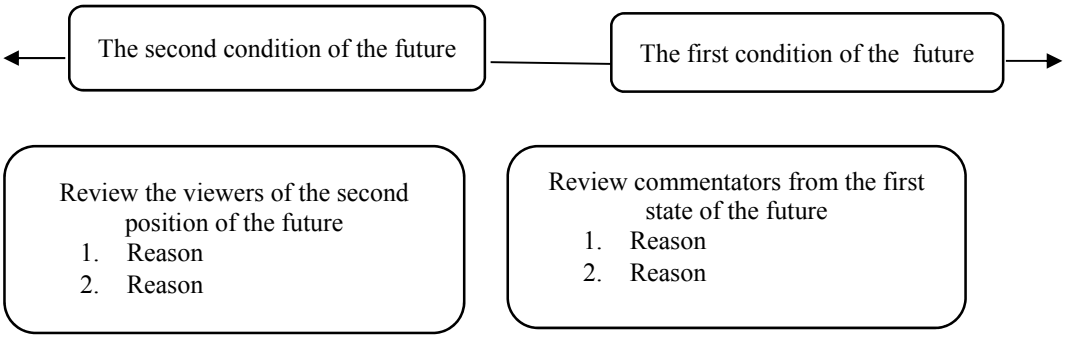
The present study is a descriptive research because it describes the flow of multi-criteria decision-making techniques of research science in operations (what it is) in a certain period of time. Due to the novelty of research on the role of futures research in the world, especially in Iran, it was decided to conduct a case study in this regard and in the field of multi-criteria decision-making techniques. In this study, semi-structured interviews with a theme analysis approach were used. The aim of the research is to identify the initial ideas for developing theoretical models for future experimental research based on qualitative findings. Also, based on the results of this research, it is possible to identify ideas (brainstorming) that can be used for quantitative research with large statistical samples. The present study seeks to better understand the process of developing knowledge of multi-criteria decision-making techniques and to provide suggestions for the development of this scientific field. As a result, the current research is a fundamental-developmental research. In fact, the researcher intends to develop the frameworks and classifications of previous researchers and provide more complete frameworks and determine what the development process of multi-criteria decision-making techniques has been and the gap between the past movement of this science and the need for development in Identify the future and then identify a plausible scenario. Also in this research, scenario analysis method was used. Among the various methods of futures research, the method of this research is scenario planning. In determining the scenario, the fuzzy Delphi technique was done by collecting the opinions of experts and specialists and using a questionnaire and sending it several times. The critical uncertainty approach was also used to develop a plausible scenario. This approach is one of the acceptable methods for developing scenarios. The statistical population of this research was divided into two parts, the first part of collecting research

information, which includes reviewing articles published in reputable and specialized journals of operations research and multi-criteria decision making including omega, operations research, and other reputable foreign and domestic journals in this Is the domain. The second part is the opinions and reviews of experts in multi-criteria decision knowledge. Due to the specialization of the surveyed topics and the need for familiarity of our experts in the field of decision-making techniques, especially in the field of soft operations research and futures research, it was decided to pay attention to the nature of the snowball sampling method. It is used that our sample members are not very transparent, use this method. For this reason, it was tried to use the faculty members of Industrial Engineering and Industrial Management in the universities of Tehran, Tarbiat Modares and Shahid Beheshti, Azad University in this research. The number of experts considered in this study is 15. Sampling of this research was done in two stages. Sampling in the first stage of this research, among the articles and specialized publications in operations research, 32 of which were selected to review the content, to review the abstract and the results of these articles to analyze the theme. Finally, through the analysis of these selected articles, the research uncertainties, which are four uncertainties, were identified and the criterion for designing the questionnaire was identified. Each of the four modes, which includes: low attention to social issues versus high attention to social issues, low attention to ethical models versus high attention to ethical models, low attention to soft approaches versus high attention to soft approaches Low attention to complex issues vs. high attention to complex issues indicates a specific dual situation in the future. Each of these dual situations represents uncertainty about the future of multi-criteria decision-making and gray theory. The reasons for the fans of the first and second situations for each case are shown in Figure 2. In each case, two questions about respondents 'expertise, respondents' agreement

to dual situations of uncertainty, and the importance of uncertainty in policy-making in the area of operational research decision-making are addressed as follows.

Figure 2

Demonstration of Uncertainties in the Questionnaire



As shown in Figure 2, two believable situations from the future of the research topic are shown, and this two-way diagram shows two possible situations. At the bottom of the situation, the reasons for each are examined and the opinion of experts on the degree of agreement with each situation is questioned. To review the questionnaires and collect their results in the research scenario, it is necessary to consider indicators in order to examine the answers, so two important indicators, which include expertise and consensus, were used. The Expertise Index seeks to examine the degree of expertise of experts on research topics and questions, and the Consensus Index seeks to know the extent to which experts in a scientific field have a consensus on a subject. The closer the consensus index is to zero, the greater the difference of opinion among experts in a scientific field on the subject under consideration, and vice versa, and the closer the expertise index is to zero, the less expertise

the subject under consideration has. Are and vice versa. Sampling in the second phase of this study was among the leading experts and professors of operations research in universities in Tehran and other cities in Iran. In this research, in the first stage, purposive sampling method and in the second stage, judgmental sampling method were performed.

Findings

Research themes are divided into two parts: themes related to multi-criteria decision making techniques, themes related to different problem situations, research themes from articles in prestigious European and American journals, and domestic management in the field of management science and research in Operations and decisions were extracted. These publications include: "Operational Research Association", "International Association of Management Science" and prestigious publications on internal operations research (Lahijan Operations Research Journal, Management Futures Research Journal, Industrial Management Organization, etc.). They are considered as the most authoritative journals in the field of research in operations and decision-making techniques. The articles of these publications were used to consider all the currents and approaches of research in operations and to increase the validity of the results. These two foreign journals have a strong interest in publishing articles in the fields of philosophy, history and methodologies, and soft operations research. The impact coefficients of these publications in 2018 and the last 8 years are given in Table 5.

Table 5

Selected Publications for Extracting Themes

Affect Factor in the last 8 Years	Impact Vector in 2018	Journal Title
0.984	1.456	Journal of operational research association(JORS)
2.789	3.069	International association for management science(OMEGA)
1.125	1.821	Relevant domestic publications on operational research

From the articles of these two foreign journals and reputable domestic journals, 32 articles were selected to study and extract the theme. Theoretical sampling method was used to select the articles. In theoretical sampling, sampling stops when you are saturated with data, that is, when no new ideas are created (Iman, 2016). In this study, we reached saturation by collecting 32 articles. Table 6 shows the number of samples taken from each publication in different decades.

Table 6

Number of Articles Received from each Publication

Domestic Publications	**OMEGA**	**JORS**	**Number of Selected Articles**
-	-	1	1980-1990s
2	2	2	1990-2000s
3	2	3	Decade2000-2010
5	5	7	After2010
10	9	13	total

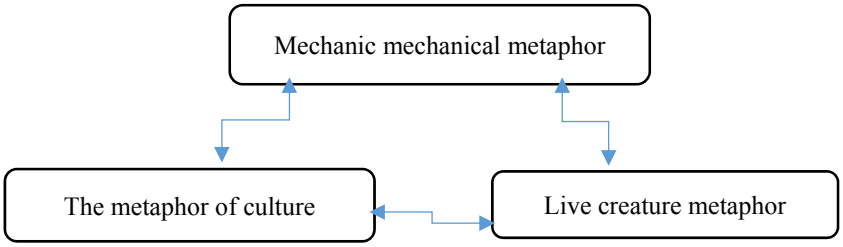
As can be seen from the table, the number of articles obtained from the publication of the Operations Research Association is more. This is because articles on the philosophy, history, theories and methodologies of research

decision-making techniques in more operations are published in this English publication. The authors of these articles are from different countries, including the United States of America, Great Britain, France, Switzerland, etc., but most of the authors are either American or English.

Discussion and Conclusions

These approaches or paradigms are: classical paradigm, critical realism paradigm, respectively. The first theme is called the various metaphors of multi-criteria decision-making techniques in operations research. Each metaphor expresses the specific view of operations research analysts on the organization. The best view is a multidimensional and multidimensional approach. Each method uses a specific perspective to examine an organizational issue. These views and metaphors are: metaphor of mechanical machine, metaphor of living being, metaphor of culture, respectively. Classical or rigid approaches from the point of view of the mechanical machine, soft approaches from the metaphor of culture, normative or critical approaches from the metaphor of conflicting systems. The conceptual categories of metaphorical theme are: the aspect or dimension of the organization that is important, respectively; The nature of organizations; How to study, measure and evaluate organizational phenomena. Figure 3 shows the different types of metaphors used in multi-criteria decision making techniques in this research. Figure No. 3. Types of metaphors of decision-making techniques (Moshbaki, 2016).

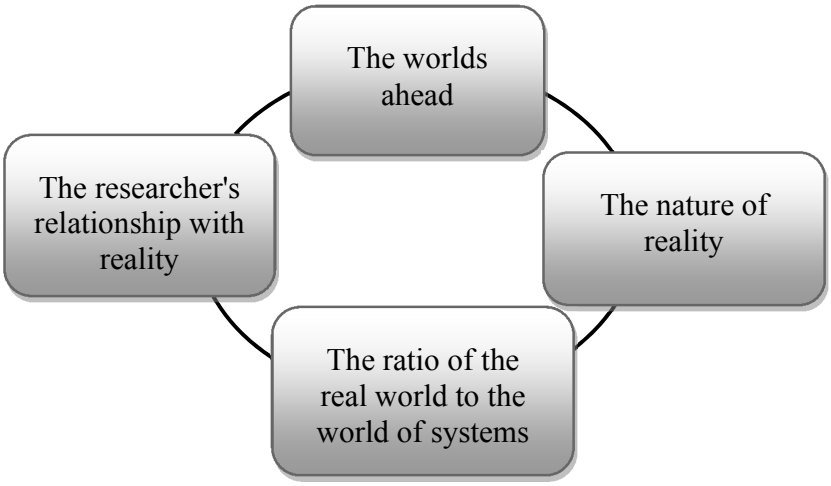
Figure 3
Types of Metaphors of Decision Techniques (Moshbaki,2016)



The second methodological theme is the ontological theme. Classical models seek to represent the phenomena of the material and physical worlds and consider the world as systems with specific goals. Reality has a tangible and objective aspect in terms of these models and is defined in the form of variables, constraints and equations. In the process of developing these models, the subject is passive and should not enter his values into the model. These models must be rigid, oblique and objective. The next approach is critical realism. From the point of view of critical realists, only real things have an effect. Reality has three levels in terms of critical realism models (including system dynamics). These three levels are: observable experiences, events, and causal structures or mechanisms. They do not consider objectivity and accuracy as an illusion. These models seek to create increasing diversity and innovation in the organization. The conceptual categories of the ontology theme are shown in Figure 4.

Figure 4

Conceptual Categories of Ontology (Ackoff, 2008)

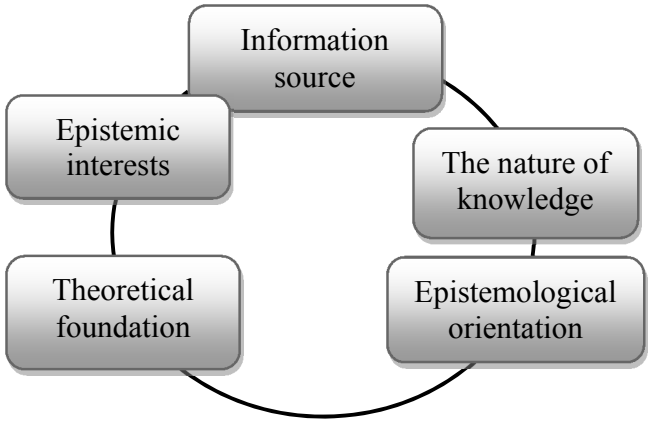


The third epistemological theme is the theory of knowledge; Theory or knowledge about the method or basis of knowledge; A theory that states: How does man acquire, acquire or will acquire knowledge of the world around him? How do we know what we are? Epistemology provides the philosophical foundation for creating the kinds of knowledge we may be able to acquire and is the criterion for deciding how knowledge can be measured correctly and logically. Classical or rigid models are based on quantitative data and seek to control and predict the phenomena of the physical or material world. These models are based on technical affiliations and belong to the schools of mathematics, functionalism and naturalism. In fact, functionalists seek to control and predict real-world phenomena by applying the methods of the natural sciences and mathematics. They believe that a set of causal laws governs the world and that humans have the ability to control nature through the development of functional models. Subsequent models are models based

on the philosophy of critical realism. These models also make extensive use of quantitative data and are based on technical interests. Understanding the causal structures and mechanisms for these models is very important. Operations research models should use a wide range of data with different natures. These models are influenced by pragmatist philosophers such as Pierce and Dewey (Ackoff, 2008). The conceptual categories of the epistemological theme are shown in Figure 5.

Figure 5

Conceptual Categories of Epistemology (Ackoff, 2008)

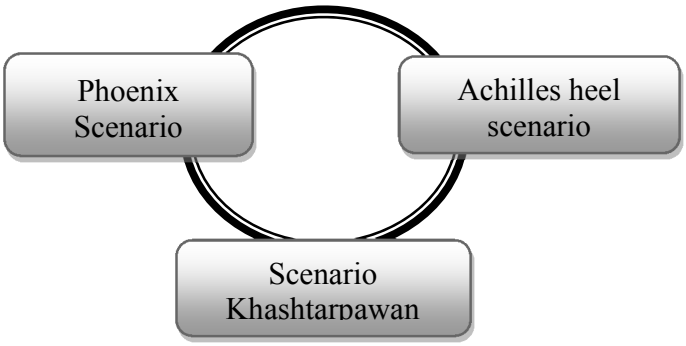


The fourth theme of methodologies is a set of methods and instructions to achieve specific goals. The methodological theme consists of four conceptual categories of model tone. Representation forms. Model validity. Classical models are deductive-inductive models and use quantitative and objective data. These models use different variables and weights to represent the equations of constraints. Critical realism-based models use causal and impact diagrams to represent reality. These models are based on retrospective

strategy and their main purpose is to identify the underlying structures and mechanisms (Ehresman, 2013). The second research question was: What are the plausible scenarios of multi-criteria decision-making techniques? Critical uncertainty approach and fuzzy Delphi method were used to develop believable scenarios of decision techniques. The uncertainty questionnaire was prepared based on the achievements of the first stage of the research and the opinions of experts. The final questionnaire has 4 dual modes. Each of these states represents a dilemma about the future of decision-making techniques. The first uncertainty was about low attention to social issues versus high attention to social issues. The results of this uncertainty show that in the past (first situation) researchers looked at the difficult issues of society but with the development of science and technology and also Problems of societies Users 'and researchers' view of human, social and objective issues of society has increased and they have studied it in their research process. The second uncertainty was about low attention to ethical models versus high attention to ethical models. The result of this uncertainty according to the questions raised in the questionnaire in dual cases shows that in the first situation, researchers look It was more quantitative and deterministic, so they underestimated moral values and prevented them from entering the model, but to develop this science in the second situation, researchers are trying to widely incorporate the ethical concerns of society and organizations into the model. The third uncertainty was about low attention to soft approaches versus high attention to soft approaches, which was done by examination and the results of the expert questionnaire show that in the first situation, researchers looked at the use of hard models and quite few in solving problems. No attention was paid to other models, therefore, attention to operational decision-making techniques from classical models to soft models was very hard and slow. But in the second situation, the results show that along with the classic and

quantitative models, other models will also grow well. The fourth uncertainty was the low attention to complex issues versus the high attention to complex issues, which the results show. In the first situation, the issues of interest to researchers and decision makers were one-dimensional and very structured, but with the development process in the second situation, ideas led to multidimensional, multi-criteria and very complex issues, the results of which led to the emergence of development models in The operation was investigated. Four modes of uncertainty according to the two indicators of expertise and consensus were used to develop plausible scenarios of decision-making techniques. Given these uncertainties, three different scenarios for the future of this science were identified. The different scenarios of operations research decision-making techniques are shown in Figure 6.

Figure 6
Scenarios of Multi-criteria Decision Techniques



In the Achilles heel scenario, soft and critical approaches have grown little and objective paradigms still dominate the discipline. But operations research academics have found weaknesses in objective methods in some interventions. Some users have noticed the weakness of these strings in

practice. Therefore, they try to use qualitative values in combination with quantitative techniques. Analysts may even try to make these hard methods more flexible. In this future, the use of qualitative methods only in different situations still faces limitations. In this future, most quantitative methods will be combined, and in the next stage, quantitative-qualitative compounds may be less used in the real world due to the low growth of these approaches, but due to the low growth of these approaches, quantitative-qualitative compounds (between -Paradigm) also faces limitations. This is why this scenario is called the Achilles heel, because despite the significant growth of some approaches, there are approaches that have not grown much. The next scenario is called Khashtarpawan. In this future, all approaches together have considerable recognition and power. Each approach has its own thinkers, experts, publications and conferences. Each of these approaches seeks to use its own methods to address specific issues. For example, thinkers and analysts of objective approaches will use a combination of mathematical and statistical models to examine operational and pragmatic problems, and will pay less attention to social and normative problems. Instead, thinkers will use soft and critical approaches by developing whatever Most methods and models based on social science achievements will examine the normative and social issues of organizations. Proponents of objective approaches will pursue their own interests, and thinkers of soft and critical approaches will pursue their own interests. In the future, quantitative-quantitative and qualitative-qualitative intra-paradigm research will grow widely, However, qualitative combinations will be considered to address more complex and strategic issues. Inter-paradigm (quantitative-qualitative) research will not grow much in the future for a variety of reasons. Finally, we turn to the latest plausible research scenario, Phoenix. In this future, different approaches each have a lot of power and have grown well. That is, along with mathematical and statistical

approaches, qualitative approaches have also grown significantly. In this future, the paradigm contrast view has become a paradigm convergence and adaptation. A wide range of methods are combined to examine different issues of organizations. These compounds are of two types: intra-paradigm compounds and inter-paradigm or inter-paradigm compounds. Quantitative-quantitative, quantitative and qualitative-qualitative methods are intra-paradigmatic combinations and quantitative-qualitative combinations are inter-paradigmatic combinations. In the future, the educational topics of operations research will be very diverse and diverse, and the development of decision-making techniques in different countries will largely depend on the cultural variables of that country. This scenario is similar to the normative scenario of the researcher. The research paradigms are the classical paradigm and the normative critical paradigm. Methods such as mathematical programming are part of the classical paradigm; Methods such as system dynamics, complexity theory and multi-criteria decision making are also postmodern methods.

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