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Methodology of Soft Operational Research

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Abstract

In the past four decades, new approaches and methodologies have been developed to solve unstructured and messy problems with various stakeholders. Among these methods, soft system methodologies, cognitive mapping, and strategic choice approach are specifically worthy to be heeded. The methods mentioned above, which have a precise structure and clear framework, are often categorized as soft operations research or problem structuring methods. Today, there is ample literature on soft research and it is taught in many operations research/management science courses of reputable universities. Methods of research on soft OR are rooted in soft system thinking and belong to the interpretative/learning paradigm. Nonetheless, assigning a clear and precise boundary between hard and soft OR techniques is not easily feasible, for most of these techniques– based on their application in different situations – can be classified as both hard and soft. The aim of this research is to investigate the origins and current position of soft methodology of operations research and probe into its theoretical basis. A comparison between the trend of OR in the US and UK clearly demonstrates the differences in soft and hard approaches. Generally, it can be concluded that soft and hard approaches of OR are complementary: soft methods are exploited in forming the structure (configuration) of a problem and hard methods are utilized in solving it.

Keywords: Soft OR, interpretation/learning paradigm, problem, system thinking.

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1. Introduction

Operations research (OR) was first developed as an interdisciplinary field in the 1940s. Although this field was based on the methodology of natural science, its aim was to solve problems by applying appropriate and available methods and data. As the mathematical techniques were developed, OR increasingly dominated the field. However, during the 1960s and 1970s, the weakness of pure mathematical methods of operations research became apparent. Churchman in 1967 drew the attention of scientific society to the ill-structured and confusing social problems with multiple decision makers. Ackoff [1] stated that the main soft OR methods, namely Soft Systems Methodology (SSM), Strategic Options Development and Analysis (SODA) and Strategic Choice Analysis (SCA) were established in order to respond to the real world.

Nowadays, it seems that 30 years after the birth of soft OR, the approach has reached its maturity in different aspects. These methods have been academically well-developed, and well-utilized in various situations. Moreover, there is appropriate literature in this subject. Yet, from another point of view, this development is just exclusively limited to United Kingdom and other United Kingdom oriented countries namely Australia, New Zealand and Canada and there has been limited research in the context of soft OR in other European countries and the United States [2].

In this paper, first, different kinds of problems in OR are introduced and the role of soft and hard methods of management science in problem solving is described, which is followed by an analysis of system

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thinking and the origin of hard and soft approaches of management science. Then, the nature of soft OR methods and their overlap with soft methods are discussed and some popular methods in the area of soft techniques in management science are well introduced. In addition, the position of soft and hard techniques in management science paradigms is pinpointed. Finally, by analyzing the differences between management science in the US and UK, it is attempted to differentiate between hard and soft approaches.

2. Problems in operations research/ management science

The term "Problem" in management science is often used in five different concepts [3]:

2-1. Raw problems (Messes)

A problem can be completely unstructured, disordered and non-classifiable. This kind of problems, which state the overall objectives and emotions, cannot be organized and classified. In addition, these problems have no specific and clear objectives and encompass quite a large number of stakeholders.

2-2. Verbally structured problems

It may be possible to describe problems by considering and analyzing raw problems, which are verbally structured and are based on the quantitative data and practical experiences. This level of problems is named expertise level. Moreover, they often require various specialties in different fields.

2-3. Mathematical models prototypes

In contrast with natural problems (problems in level 1 and 2), there are some ideal standards in OR named mathematical model patterns. These models, as well as linear

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programming, can be stated by mathematical terms:

$$Max\ cx$$

$$subject\ to$$

$$Ax \leq b$$

$$x \geq 0$$

Or can be presented by verbal standards such as Knapsack, Travelling Salesman Problems, etc. OR/MS can propose standard algorithms for most of the models. Many problems in the literature of OR are classified in this category (Muller-Merbach, 2010).

2-4. Real world models

Fourth level, which is in fact a combination of previous levels, is a model with real data. This model is suitable for real-life calculation. Therefore, it may be required to use different sets of data with large number of iterations.

2-5. Training problems

Small-sized numerical examples of mathematical models (third level) are appropriate for training aims.

There are close inter-relationships between the five presented levels. General patterns of level 3 are different from the ones in level 4 and 5. Training books about OR emphasize on level 3 (patterns) and level 5 (examples). Yet, operations research/practical management tends to move from level 1 to level 4 through levels 2 and 3.

Scholars have different opinions about whether or not the power of problem solving techniques is just restricted to a special set of problems. In the context of system science, related ideas can be classified into two following categories:

I. The system science can almost solve all the problems through system thinking (soft system thinking).

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II. The system science has limited tools. Thus, it can just respond to a limited range of problems. In another words, OR can just be considered as a mathematical tool (hard system thinking).

3. System thinking

System can be defined as a set of resources which are designated in order to achieve the desired objectives. Generally, system thinking encompasses the environment of system by considering its dynamics, and nonlinear and stochastic processes.

System thinking, through emphasizing on correct problem identification in initial stages and utilizing some special techniques, provides an independent structure and identity. In other words, it is a kind of supplement for hard system thinking. In fact, the value of soft system thinking refers to its capability in recognizing problem situation in a structured manner [4]. System types can be classified according to Figure 1.

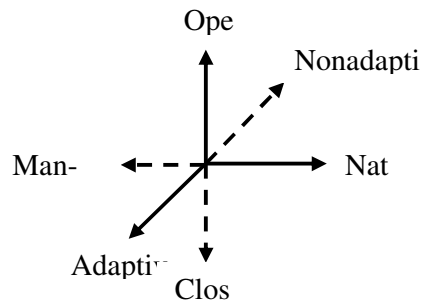

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Figure 1- Systems types in three-dimensional space (Adapted from [5]).

According to classical (hard) approach, system is just a subset of the world, which requires engineering and optimization. But, in soft system thinking, system involves the process of interacting with the world. In another word, soft methodology was established in order to improve the ill-structured social systems.

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Considering the dominant state of soft system thinking and neoclassical operations research, both complementary approaches of soft and hard systems is required in order to solve a problem in the right manner. Complementary role of hard and soft approaches toward system thinking, in which there are different type of insights, is describable in initial and final steps of problem solving. In primary steps, a general thinking is necessary to recognize and understand the nature of the problem and its dynamic environment. Therefore, SST and broad perspective about problem are necessary for analysts. Yet, precise and technical insight plays the key role in the final steps, which are more operational. This is the reason why analysts tend to apply hard system thinking. However, there may be different classifications and other approaches which can be useful in the ending steps alongside the hard approach. The presented concepts are illustrated in Figure 2.

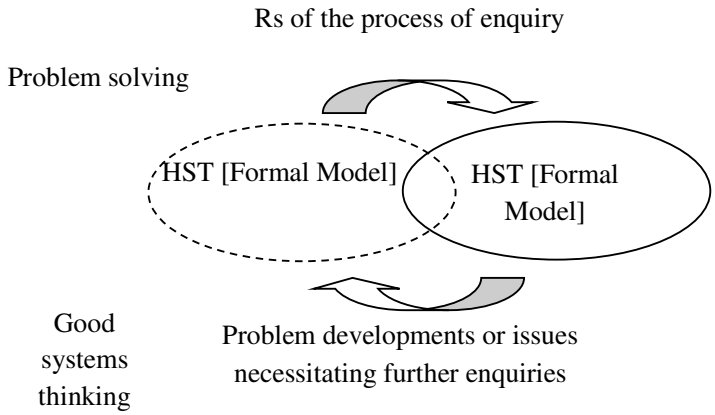

Figure 2 must be inserted here. Figure 2. The complementary role of

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system thinking in problem solving (Adapted from [5])

4. The nature of soft OR

Messy problems and soft methods:

Mingers [2] summarized the common characteristics of messy problems – the ones that cannot be solved by traditional instruments for OR (hard approach) [6] - into the following categories:

- The specific objectives of problems cannot be well defined. A good example is the integration project and special service improvement for children in two healthcare organizations in UK, where some complexities and messiness existed. There was no accurate definition for special services. Also, there was not any agreement on available services in the subject of project; requirements were ambiguous in a wide range of subjects. Since a number of organizations are involved in children welfare issue, no agreement had been reached on the future of children services as well as the way project should be handled. Moreover, there were a lot of political aspects at both local and national levels. In this condition, even non-optimizing methods such as critical path analysis, simulation and decision analysis cannot be applied [7].
- These problems involve several stakeholders and parties that can be within organizations or external cooperating bodies. These issues lead to the development of different perspectives toward the problem situation.
- There are several uncertainties and lack of reliable data.
- "Success" requires a proper degree of agreement among the parties involved in particular programs. However, the agreement about the

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nature of the problem may ultimately lead to the application of traditional operations research methods. In this situation, processes are often based on learning and negotiation rather than technical solution of the problem.

These kinds of complicated problems have been recognized for a long time. Ackoff [1] called them messes as opposed to the problems. Other expressions, used for these kinds of problems are: wicked versus tame problems [8], swamp against high ground, practical as opposed to technical problems [9], and soft versus hard [10]. Soft problems are usually noticeable and affective. From another point of view, strategic term versus short term and narrowly-focused can be applied for soft problems.

Considering the described situation of complex problems, characteristics of soft OR methods, which may aim to analyze the problems, can be stated as bellow [2]:

- Although soft methods are not mathematical, they are well structured and accurate. They are based on qualitative modeling procedures and sometimes may include numerical information, but not at the level of complicated equations.
- These methods provide a wide range of perspectives and encompass multiple and contradictory objectives without removing and converting them into financial measures.
- These methods encourage the cooperation of stakeholders in the process of modeling. Therefore, models should be clear for participants.

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- Due to the lack of reliable quantitative data, uncertainty may happen.
- The primary goal of these methods is exploration, learning and providing commitment among stakeholders rather than optimization, which is the goal of hard methods.

Due to the differences in experts' point of view and the nature of these methods, it is not possible to draw a clear borderline between hard and soft methods.

5. Impossibility of differentiating hard and soft techniques in OR

The main aim of all operations research methods is to help decision makers in complex situations where there are a great number of alternatives and a wide range of contradictory criteria and objectives. These methods can be generally called decision analysis (DA). In these methods, there is a degree of conflict between different perspectives. In order to recognize the differences, two multiple decision making approaches are analyzed.

The first approach is analytic hierarchy process (AHP). Forman and Gass [11] stated that AHP is a simple analysis tool as it has three following functions:

- Structuring complexity through modeling in a hierarchical form, in which goals are in the top and alternatives are in the bottom level,
- Measuring preferences through pair-comparison between alternatives and transforming the preferences of one or more decision makers into quantitative weights,
- Combining the above issues and prioritizing alternatives.

Obviously, AHP is a general approach which has been utilized in complicated situations. It integrates

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the ideas of decision maker groups [12]. Although AHP is useful in unstructured situations, it cannot be properly assigned to soft category. Some American scholars state that AHP is a hard technique, since the goals and criteria can be well defined.

The second perspective, which was initiated by Phillips [13] in 1993, is named decision conferencing. In this approach, some workshops are held by participation of the main decision makers. In these workshops, a facilitator manages the group instead of directing the problem content. The focus of this approach is to understand the alternatives and their results rather than to propose a model which determine the correct answer [14]. Mingers [2] states that this approach is compatible with soft OR methods, because it facilitates the process of group decision making with quantitative modeling.

ELECTRE [15] and PROMETHE [16] are two methods which were developed on the basis of this perspective. Both proposed methods are in the category of ranking methods. There are different versions of ELECTRE, each of which is used for a special type of problems: Selecting the best alternative and ranking or clustering alternatives.

Considering these techniques as a part of soft OR largely depends on how they are applied to problems. The methods will be in the soft category if they are used as a facilitator for interactions with decision makers and focus on the decision process rather than decision making [2].

6. A paradigm oriented approach toward the development of management science

In this section, operations research paradigms are briefly described. The

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detailed analysis of these paradigms reveal that the origin of hard OR is optimization and the origin of soft OR is interpretative/learning paradigm [17].

6-1.The optimization/normative paradigm (1940-1960) – problem solving methods

Checkland [4] states that the emergence of hard system thinking is the result of system analysis and engineering analysis developments in the United States [18]. This paradigm is based on the assumption that a decision maker decides in a bounded rational manner and is able to select between alternatives with the complete knowledge about the problem. These methods are compatible with functionalism in social sciences. However, management science attempts to optimize the operations. Optimization paradigm and the development of problem solving methods are related to the classical OR techniques or hard approach.

The ontology of this paradigm emphasizes on the existence of systems as an objective reality. Systems as independent entities exist in the real world. According to this paradigm, management activities are rational processes of decision making. Also, the methodology of normative paradigm intends to provide the linkage between variables and identification of basic structures.

6-2. Interpretative/ Learning Paradigm (1970-1980), Situation- improving methodologies

Since the methods in this paradigm attempt to investigate messy problems, Ackoff [19] named this paradigm "design perspective. Some of the methodologies associated with this paradigm are Soft Systems Methodologies (Checkland [20]),

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Interactive Planning (Ackoff [?]), Strategic choice Approach (Friend [21]), Social Systems Design (Churchman) and Cognitive Mapping (Eden [22]). As it is clear, this paradigm encompasses a great number of soft OR methodologies.

American pundits of system thinking like Churchman and Ackoff greatly influenced the development of British methodologies. Among the introduced methodologies, those which have been well examined and validated are SSM, SODA and SCA, that are more commonly used in UK and the IP approach is the most similar method to American perspective [23]. Unlike the objective reality view in optimization paradigm, reality has a social structure in interpretative/learning perspective since it is formed through subjective understanding.

6-3. The critical paradigm (1980-1990), intervention-empowering methodologies

During the 1980s, a new set of methodologies was developed based on the critical system movement of British thinking. According to the philosophy of these methodologies, social systems are unequal. Therefore, system thinking should concentrate on the subject of inequality between participants. Empowering all participants is the main characteristic of this approach.

One decade later, a new debate in systems and operations research societies emerged, in which the application of more than one methodology or a combination of them was recommended. Franco and Lord [24] stated that due to the complex and multidimensional nature of problem in the real world, it is inevitable to use multi-methodologies in order to solve the problems.

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Having recognized and investigated the strength and weakness of combining methodologies in different paradigms, practitioners and scholars realized that two developed multi-methodologies perspectives can be represented:

- "The coherent pluralism" by Jackson
- "The critical pluralism" by Mingers

6-4. Postmodern approach in management science (2000-present), multi paradigm methodologies

This paradigm is considered as a new development in management science and is based on the rational critique embedded in modernism. Moreover, this approach undermines the dominance and holistic nature of other paradigms. The attitude of this approach toward organization is compatible with carnival metaphor.

The main finding obtained from investigating these paradigms in this paper reveals that the hard approach comes from optimization/normative approach. However, soft paradigm propagated in Europe is derived from the interpretative/learning paradigms.

7. Problem structuring methods (PSM)

Well-structured problems are the ones that can be practically formulated based on the criteria, constraints and relations. This type of problems can be well defined by classical OR methods (hard approach). Yet, there are unstructured problems that have led to the creation of structuring methods. The characteristics of these problems are as following [25]:

- Multiple stakeholders,
- Multiple perspectives,
- Unclear and conflicting interests,
- Intangible factors,
  - Uncertainties.

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It is emphasized that these problems are more "strategic", since they provide basics for well-structured problems as a result of a problem structuring process [26]. So, it might be better to discuss different aspects of problems, rather than different types of problems. Problem structuring methods offer course to form a model to describe situations. Also, they can help participants and stakeholders to obviously clarify the situation. To do this, PSM should have the following characteristics [25]:

- Being able to provide a conjunction between alternatives,
- Being cognitively accessible for all participants with different education and knowledge,
- Operating iteratively: the problem reflects stages of debate among participants,
- Being able to address the partial improvements rather than proposing a general solution which would imply to emerge from the stakeholders' interests.

As a result of the mentioned requirements, problem structuring methods use primary and simple mathematical and statistical tools, despite the fact that they seem complicated in conceptualization and interaction with the current decision making process. These methods can be well used in particular situations. Moreover, those methods that have been practically applicable commonly use the creative methods which have considered the environmental conditions. In the following, some of the popular methods are summarized:

7-1. Soft systems methodology (SSM)

Peter Checkland, as the originator of this methodology, by applying some changes in the methodology of hard

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systems engineering, provided a structure which was more compatible with the human mind [18]. The subjective roots of soft systems methodologies can be found in Churchman's works (particularly dialectical inquiry) and interpretative psychological issues in Vikers' works (particularly social processes). The steps of soft systems methodology can be briefly stated as the following:

- Explore as much as possible about the problem situation, particularly its background, nature, the dominant culture, and political authority.
- Create a systematic model of activities which clearly assures considering different perspectives and approaches associated with the situation. Propose the basic definition.
- Apply the model for questioning and exploring the situation through providing a debate between stakeholders in the context of required and possible changes.
- Achieve an agreement on the changes in the situation (problem) in a way that different points of view can be emerged.

In summary, soft systems methodology is a general method for redesigning systems. In these systems, participants draw the ideal conceptual model from their own point of view and compare it with the current system. Thus, the desirable cultural and systematic changes can be addressed [5].

7-2. Cognitive mapping/SODA

Colin Eden and Colleagues spent a lot of time to develop a strategic decision making method. They developed a method named cognitive mapping, which became a part of a general approach; SODA. Cognitive mapping can help to recognize the feeling of participants involved in a

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situation. One of the reasons why the problem becomes messy and complex refers to peoples' different understandings and perceptions. This technique is based on the psychological theory of "personal construct". In fact, cognitive mapping represents the understanding of people toward the problem situation. Its bipolar construct denotes the existence of contrast between related concepts. The output of this technique is similar to casual loops, although cognitive mapping is obviously subjective and uses constructs rather than variables. Individual cognitive mapping is used as a tool of negotiation between participants in decision making process and consequently leads to the creation of an agreed group map. As it was mentioned, cognitive mapping is utilized as a key tool in a more comprehensive process of establishing strategy. The process is briefly summarized as follows:

- Applying cognitive mapping derived from individual interview in order to make organizational strategy more understandable in terms of strategic principles, goals and beliefs,
- Holding facilitated workshops, group discussion meetings and negotiations to gain agreement about group strategic maps and particularly developing decision support software,
- Monitoring strategy progress and organizational learning.

Strategic options development and analysis is a general method for addressing problems. This method uses cognitive mapping as a tool to determine participants' perspectives associated with problem situation. Synthetic cognitive mapping provides a framework for group discussion in which one person, as a

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facilitator, directs participants to gain consensus on a set of activities.

7-3. Strategic choice approach (SCA)

In the 1960s, this approach was developed in terms of sociological perspective [21]. SCA as a soft version of system analysis, differentiates stakeholders and their attitudes, and considers uncertainties and lack of information. This approach consists of four following steps:

- Formation: initially, decision makers determine the decision areas in terms of their importance, priority and inter-relationships. The aim of this step is to determine the main pivots and project boundaries.
- Designation: The possible alternatives for all decision areas are discussed. Afterwards, the alternatives are examined in a pairwise manner in order to find the mutual incompatible ones. This way, all possible combinations of alternatives are considered. In these stages, the uncertainties become apparent with regard to the decision making environment, political consideration and beliefs.
- Comparison: Considering participants' criteria, different decision plans are defined and compared. Consequently, a continuum of various qualitative and judgmental values proposed by the stakeholders is emerged. In this step, a pair-comparison among decision plans (using a comparative advantage grid) is required to determine the position of each advantage into the related dimension and its uncertainties level.
- Selection: Finally, selection is made based on stakeholders' consensus. In this step, the mentioned

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uncertainties are well described. It is possible that some decisions are postponed in order to reduce the uncertainties.

This approach, as well as other explained methodologies, is a participative approach and is usually carried out through facilitating workshops and the engaging parties in decision making procedure. In all described methods and methodologies, experts of operations research practice as facilitators. Generally, it can be concluded that structuralizing problem methods are a part of soft operations research, which get help from stakeholders to analyze sophisticated problems [27]. Some other methods in soft operation research category are summarized in Table 1:

Table 1- other soft operation research method (Adapted from [2])

Method	Description	Theoretical underpinning
Critical systems heuristics (CSH)	Used to challenge the boundaries drawn up to circumscribe the focus of planning or design	Churchman's dialectical approach and Habermas's critical theory
Hypergames, metagames and drama theory	Soft game theory used in situations of competition and conflict	Game theory
Robustness analysis	Used to decide on commitments now in the light of their robustness to uncertain futures	Decision analysis and planning methodologies
Interactive planning	Used to assist participants design a desirable future for their organization and bring it about	Pragmatism and systems theory

It is important to note that the hard techniques can be used in a soft form. In other word, it uses the model as a representation of attitudes

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or opinions and the people's perceptions toward reality rather than a representative abstraction model from reality [28]. Some examples in this context are qualitative approach of system dynamic [29], MCDA [30], the visible systems model and generally the mathematical models.

8. Operations research and operational research: comparing two pioneer countries (United States and United Kingdom):

An investigating into different approaches toward OR in US and UK provides a deeper understanding from soft and hard OR. In order to analyze the differences in terms of the approaches in these two countries (as the most important countries in management science), it is better to start from the names assigned to this branch of management science in these countries. In the US the term "operations research" is used, while in UK it is called "operational research". The differences in these two terms are not accidental. More accurate investigations reveal that the term "operations research" consists of two names, which emphasize on the action or the method of practice. The importance of what happens in reality (action or operations) in that this term reveals its ontological tendency. On the other hand, "operational research" is a combination of one noun (research) and an adjective (operational). "Operational", which means "using for operations", explicitly emphasizes the importance of process. This issue gives an epistemological tendency to the term. Grammatical investigation of proposed terms reveals that management science in UK follows

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a more systematic and interpretative approach [17].

Another way of investigating the differences is to search in the specialized journals of OR. Mingers [2] achieved interesting results by analyzing the keywords which reveal the soft approach toward OR in five reputable journals from the beginning of 2007. The keywords were: methodology of soft systems, problem structuring (configuration), cognitive mapping, soft OR, strategic choice approach, critique systems, meta-games, hyper-games and dram theory. The findings of the research on the keywords are presented in Table 2. Table 2 must be inserted here.

Table 2- Numbers of occurrences of key-words in search of Web in reputable Journals in the US and UK (Adapted from [2])

Key-word search term	Soft systems methodo logy	Problem structuring	Cognitive mapping/ SODA	Soft OR	Strategic choice approach	Critical systems	Drama theory, hypergames, metagames
JORS	34	55	13	98	4	18	7
EJOR	5	11	6	30	2	2	6
Interfaces	2	2	0	6	0	0	0
Operations research	0	0	0	0	0	0	2
Management science	0	0	0	0	0	0	0

JORS and EJOR are British journals. However, the other mentioned journals are American. According to this table, American journals are not interested in publishing papers with soft OR approach.

One of the reasons why soft OR could not attract attention is the common belief that it is not real, while problems are not completely explicit and clear. Problems always stem from the results of decisions and experts' judgments. Minger states that OR is soft per se and is only possible when it is structured and formulated [5].

Another reason refers to the American approach to operations research. In this perspective, soft OR is not considered in the area of operations research. In fact, in

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the US, soft OR is taught in some departments other than OR department. Moreover, the background of a great number of these techniques is related to psychology and sociology. This shows that plenty of American universities in different fields consider soft OR important and publish their studies on reputable journals (except for operations research journals) such as MIS Quarterly or An Strategic Management Journal. The question which remains to be answered is that if these individuals consider soft OR valuable, why American OR journals don't think as such?

On the other hand, one can take a historical look at the process of the formation of OR: during 1970s, operations research, especially in the US, became extensively theorized and tended toward math. This tendency separated this field from practical issues in the real world. Interestingly, Ackoff and Churchman in the 1960s, gave this phenomenon an advance notice, criticized it and published their views in operations research and management science journals. But after 1960s, when the crisis of operations research deepened, their papers were solely published in European soft OR journals. Kirby [31] analyzed this period and discussed that the US did not follow UK's lead for complex cultural and economic reasons. The explanation of these feedback loops and general schematic of this map is presented below:

Loop 1, publications: when a journal becomes popular in a specific field, it attracts more articles in that field. Due to the lack of previous publications about soft OR, the number of submission decreased.

Loop 2, editorial policies: selecting articles is influenced by the editorial policies. This decreases the number of submitted articles in soft OR. The policies of editorial, in turn, are

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influenced by the approach that soft OR is not operations research and this leads to a decrease in soft OR articles in reputable journals.

Loop 3, soft OR unfamiliarity: one of the reasons that submissions of these papers are low is that soft OR is unknown in the US.

Loop 4: validity: soft OR, due to the low number of published papers and inappropriate perspectives has shaky validity.Loop 5: Promotion: lack of articles in soft OR and its little validity in the US, has led to an inhibitive rather than supportive view.

Loop 6: Success in practice: Soft OR has been successful in practice. But due to the editorial policies and the low number of articles about the application of these methods, they have been unknown.

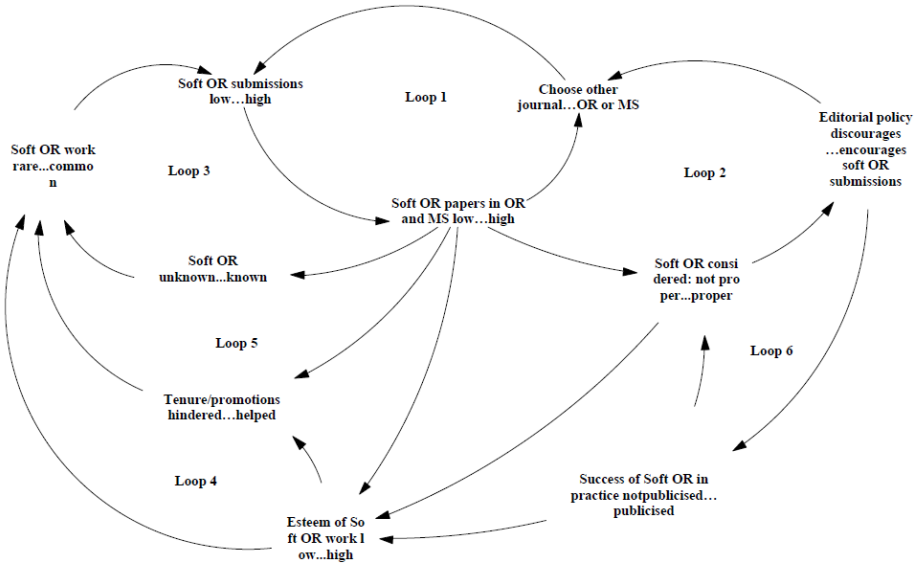

Figure 3- Mingers' conceptual map about the feedback loops of not publishing soft research articles in the US

(Adapted from [2])

9. Conclusion

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The aim of this article is to investigate the origins and current position of the methods which are considered fairly uncommon in OR. In the last forty years, a plethora of methods was devised to vanquish the complexity of ill-structured problems that regular conventional math-based techniques were incapable of solving. These techniques are called soft OR. Mingers [2] presented a host of evidence on the scientific and practical achievements of soft OR and concluded that these methods are mature enough.

The reason these techniques are uncommon, however, can be sought in their confinement in Britain (as the birthplace of a plethora of soft OR techniques) and similar countries. It is discussed in this article that to what extent some techniques can belong to the soft OR approach; the response would be that a lot of apparently hard techniques – especially in the field of multi-criteria decision analysis – can be classified as the techniques of soft OR, provided that they are used according to the principles of soft operational research. However, a large proportion of soft techniques of OR are problem structuring methods; some of them are decision support, which use the stakeholders to compromise on the problem and make them committed to the future actions. These methods are generally exploited to recognize and clarify the inner- or inter-organization issues [32].

Moreover, paradigmatically considering, one can recognize that a change in the system movement led to a change in management systems; through a paradigm shift from optimization to learning and then to critique – which seriously questions the first two mentioned paradigms – OR techniques varied from the

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problem-solution to situation-optimization and eventually to synthetic and pluralistic ones [33].

The reasons for the less-than-expected deployment of soft research methods in the US were discussed in the last part of the paper. These methods are neither published in important journals nor taught in the country's OR/MS courses. Mingers [2] claims that lack of attention to research on soft OR in the US – regarding the crucial role this country has in the development of management science and its pioneer OR and MS journals– is unfortunate for OR development.

Apparently, the pragmatism embedded in British culture led to the birth of soft methods in this country. It is essential to notice the fact that the two approaches of hard and soft are complementary: soft methods have a more important role in identifying, defining, and solving the right problem, whereas hard methods are more important in rightly solving (Optimized solution) the problem [5]. In conclusion, it is worth mentioning that soft methods are used in the primary phases of solving the problem (identifying the problem) and hard methods are exploited in the final phases (solving the problem).

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روش‌شناسی تحقیق در عملیات نرم

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در چهار دهه اخیر روش‌ها و متدولوژی‌های جدیدی برای حل کردن مسائل غیرساختاریافته و آشفته با ذینفعان متعدد توسعه داده شده است. از این میان می‌توان به متدولوژی سیستم‌های نرم، انگاشت شناختی و رویکرد انتخاب استراتژیک به عنوان مهمترینِ این روش‌ها اشاره نمود. روش‌های مزبور که ساختاری دقیق و چارچوبی مشخص دارند، اغلب به عنوان تحقیق در عملیات نرم یا روش‌های ساختاربندی مسائل نام‌گذاری می‌شوند. امروزه تحقیق در عملیات نرم از ادبیات علمی مناسبی برخوردار بوده و در بسیاری از دوره‌های تحقیق در عملیات / علم مدیریت در دانشگاه‌های معتبر تدریس می‌شود. روش‌های تحقیق در عملیات نرم ریشه در تفکر سیستمی نرم داشته و از لحاظ پارادایم، متعلق یعنی پارادایم تفسیری/ یادگیری هستند؛ با این حال تعیین مرزی مشخص و دقیق بین تکنیک‌های نرم و سخت تحقیق در عملیات به سادگی ممکن نبوده و بسیاری از تکنیک‌ها، بنا به استفاده در موقعیت‌های گوناگون می‌توانند سخت و یا نرم قلمداد گردند. هدف مقاله حاضر، بررسی خاستگاه و جایگاه فعلی روش‌شناسی نرم تحقیق در عملیات و بحث درباره ریشه‌های نظری این رویکرد است. مقایسه تحقیق در عملیات در دو کشور آمریکا و انگلستان به روشنی تفاوت‌های رویکردهای نرم و سخت را نشان می‌دهد. در مجموع می‌توان گفت که رویکردهای سخت و نرم تحقیق در عملیات مکمل یکدیگر هستند؛ به طوری که روش‌های نرم در تشکیل ساختار (صورتبندی) مسئله و روش‌های سخت در حل مسائل کاربرد دارند.

واژگان کلیدی: تحقیق در عملیات نرم، پارادایم تفسیری/ یادگیری، مسئله، تفکر سیستمی.

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