

# A Study on Management Methodology for the Complexity of Social System— the Combination of MCDM and SSM

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**Abstract** — This paper presented a management methodology on social system by combining the multi-criteria decision making (MCDM) and soft system management (SSM) into a comprehensive approach. In the face of many ill-structured problem in the human activity systems, either methods alone has limitations. In this study, the integrated thinking based on the combination of MCDM and SSM is applied to solve the complex social system problems with real world applications.

**Keywords** — MCDM, Social system, SSM, Complex system

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## 1. INTRODUCTION

MCDM is the study of methods and procedures by which concerns about multiple conflicting criteria can be formally incorporated into the management planning process, as defined by the International Society on Multiple Criteria Decision Making (<http://www.mcdmsociety.org/intro.html>). MCDM has been used as a decision analysis or decision making since 1960's following the rapid growth of operational research in world war II (Alias, Hashim and Samsudin, 2008). Today, it has become a very important and active field in decision sciences, systems engineering, management science and operations research, attracting a growing number of scholars to this research. Interested readers are referred to Korhonen *et al.*, (1992) and Stewart (1992) for the surveys of MCDM. MCDM evolved from single criteria to multiple criteria, then made continuous progress in decision making under uncertainty, giving rise to Stochastic Multiple Criteria Decision Making (Calballero *et al.*, 2004; Hahn, 2006; Nowak, 2007; Fan, Liu and Feng, 2010), Fuzzy Multiple Criteria Decision Making (Carlsson, 1982; Carlsson and Fuller, 1995; Ostermark, 1997; Bailey *et al.*, 2003; Chang *et al.*, 2008), seeking to deal with more management complexity of human activity systems.

SSM (Soft System Methodology) is a response to the difficulty in applying hard systems thinking to human activity systems which is complex, fuzzy and pluralistic (Checkland, 1981, 1990; Yang, 2010; Zhang, 2010). The problems in this area are usually intangible and messy, namely ill-structured (Checkland, 1981, 1999; Jackson, 2000). The classical model is its seven - stage model (Figure1) presented in Systems thinking, Systems Practice (Checkland, 1981), which is the best known today.

In order to stress that the learning cycle could be commenced at any stage and that SSM was to be used flexibly and iteratively (Jackson, 2000), in its latest account, SSM is presented as the four- activity model (Figure 2).

Faced with the complexity of Social System, MCDM and SSM both have advantages, but emphasize on different aspects, MCDM is good at dealing with structured or semi-structured decision problem, SSM is good at dealing with the ill-structured decision problems, and the two methods are complementary.

This paper is organized as follows: Section 1 describes the dual nature of social system and defines two kinds of social systems: structured systems and ill- structured systems, which require two different types of methods on management. Accordingly, Section 2 discusses MCDM and structured social system. Section 3 discusses SSM and ill – structured human activity systems. Lastly, Section 4 discusses the combination of MCDM and SSM, presents that MCDM and SSM are complementary in solving the complex social system problems with real world applications.

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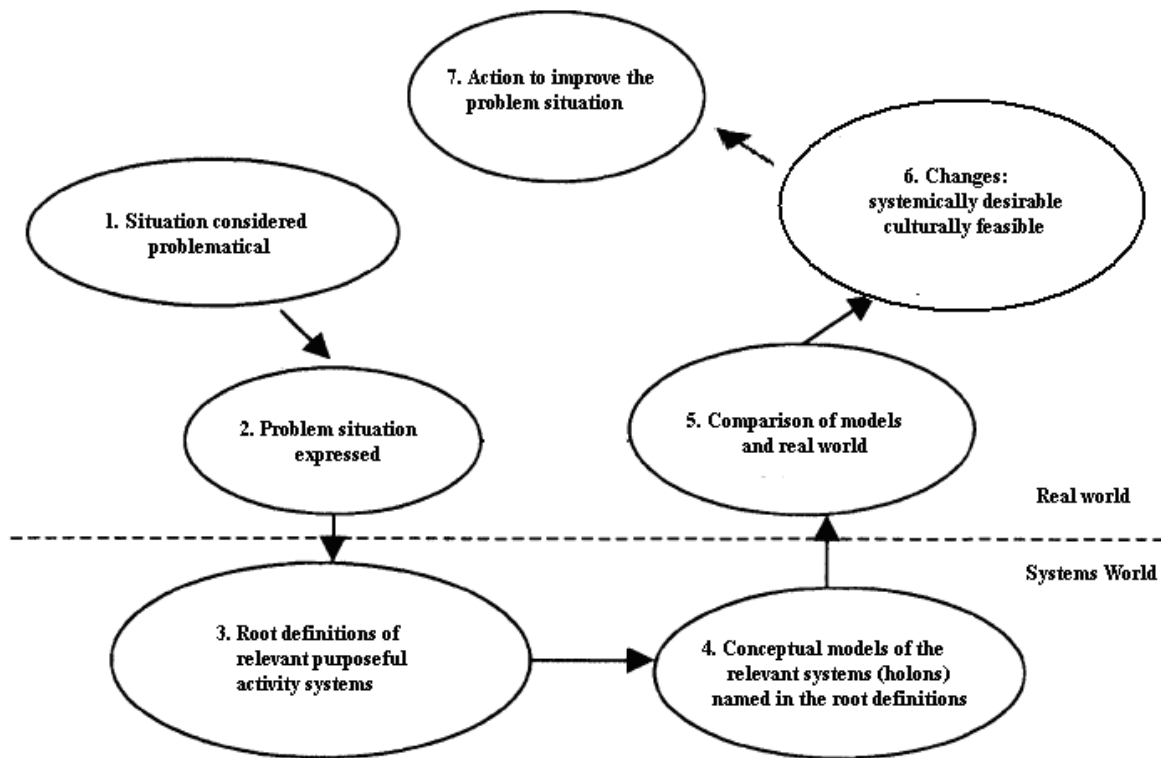


Figure 1. The classical form of soft systems methodology as a seven-steps model (reproduced from Checkland, 1989, P84)

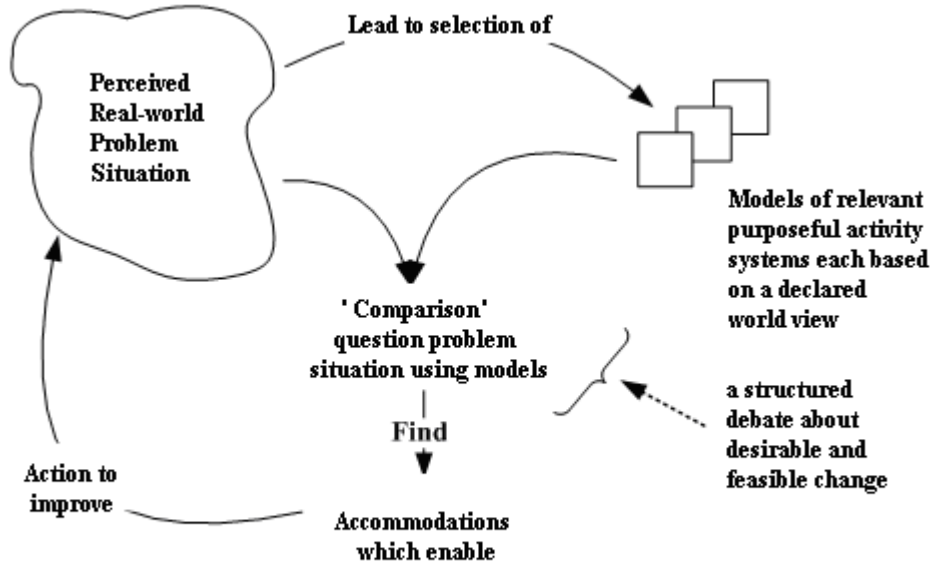


Figure 2 The currently preferred representation of SSM (adapted from Checkland, 1999, P.49)

## 2. THE DUAL NATURE OF SOCIAL SYSTEM

Checkland started from an observer and describer, suggested that the absolute minimum number of systems classes needed to describe the whole of reality is four: natural, designed physical, designed abstract, and human activity systems (Checkland, 1981). Checkland’s description of human activity systems is one of the most important breakthroughs in the development of systems thinking. Previous systems thinkers had sought to model physical systems, designed systems, even

social systems, but they had not treated purposeful human activity systemically. A human activity system is a model of a notional system containing the activities people need to undertake in order to pursue a particular purpose (Jackson, 2005). There are innumerable sets of human activities ordered consciously of which more or less in wholes as a result of some underlying purpose or mission. The range covered by this class of system is very large indeed, ranging from a small individual production system to the international political system. Checkland considers that human activity systems are totally different from natural and designed systems, as Checkland said, “There are less tangible systems than natural and designed system” (Checkland, 1981). Thus, for human activity systems, there are less objectivity. Human has self-consciousness, possesses freedom to choose purposeful action, which leads to the diversity in worldviews and values. Different observers have different understanding of the boundary and the purpose of a particular human activity system. Subjectivity has been stressed more in this type of system. “The difference lies in the fact that such systems could be very different from how they are, whereas natural systems, without human intervention, could not. And the origin of this difference is the special characteristics which distinguish the human being from other natural systems” (Checkland, 1981).

Checkland suggested that social system has a dual nature which comes from the two systems classes involved, that is human activity systems and natural systems. “I suggested that social systems should be placed astride the boundary between human activity and natural systems, to mark their equivocal nature. The activities associated with a social system, and the connections between them are certainly amenable to rational design; but any actual manifestation of such a system involving a group of real people will exhibit properties due to the natural characteristics of man the social animal.” (Checkland, 1981). “Any actual social system observed in the world will be a mixture of a rational assembly of linked activities( a human activity system) and a set of relationships such as occur in a community (i.e. a natural system). In practical work in the real world it will be necessary to take both aspects into account. A purely behavioral approach based upon the idea of man as a gregarious animal will neglect the power and influence of rational design; but an approach which assumes human beings to be rational automata and ignores the cultural dimension will also pass the problems by” (Checkland, 1981). The dual nature of social systems is implied essentially in the nature of the two classes of systems: objectivity and subjectivity, rationality and irrationality, which had formed a tension that making the traditional scientific methods not be completely appropriate for the society. As Checkland said, “the well-established methods of science will be entirely appropriate for the study of natural systems, perhaps with the addition of attempts to generalize accounts of specific examples by using systems terminology. In the case of human activity systems the way to proceed is less obvious” (Checkland, 1981). Therefore, the dual nature of the social system requires two types of methods on management. For human activity systems or human affairs systems, it is desirable to develop a method, which provide social, cultural, political and person worldview analysis for the process and structure. For natural systems or designed systems, we need another kind of method to make a target-oriented functional and logic analysis. However, the human activity systems, natural systems and designed systems are closely related to each other, what we observed in the real world is a mixture of all the system classes. Thus, starting from the system classes, we try to make such a division: In social system, some systems dominated by the natural systems and artificial designed systems, are often with a clear structure, we call it structured or semi-structured systems; while other systems, mainly for human activity systems, involving less objectivity and rationality, but more values and culture related, are often with poor structure, we call it ill-structured systems. From the point of view of management methodology, we believe that MCDM and the SSM just correspond to these two types of systems, MCDM is good at dealing with structured or semi-structured decision problems, while SSM is good at handling a variety of ill-structured or unstructured decision problems in human activity systems. However, in dealing with the complexity of social system, these two approaches are not separate, but rather complementary each other.

### 3. MCDM AND STRUCTURED SOCIAL SYSTEMS

MCDM is one of the methods of normative decision-making paradigms, from the perspective of systems thinking, MCDM belongs to hard systems approach (Fan and Kuang, 2009). “Hard systems thinking”, given by Checkland (1981), is a generic name to various systems approaches for solving real-world problems developed during and immediately after the Second World War. The approaches which most commonly associated with this label are operations research, systems analysis and systems engineering. These, however, gave rise to a myriad of other variants of hard systems thinking, such as decision science, cost-benefit analysis, planning- programming- budgeting systems and policy analysis (Jackson, 2005). Hard systems approaches can be used in areas where problems are well-defined and the objectives of a particular system can be found out clearly , namely, well structured problem in Simon’s word. In addition, the means of hard systems methodology can be quantitatively measured and optimized, and the technical factors will tend to predominate. As a result, the process of such methodology is a “how-oriented” activity which can be linearized to attain the aim step by step.

In social system, there are many subsystems, such as military systems and engineering systems, the objectives of which are relatively clear and well-defined that hard system approaches can be used effectively. Hard systems approaches, as Jackson puts it, "It is extremely helpful, in seeking to improve problem situations, if managers can clearly set objectives, seek alternative means of achieving those objectives and evaluate those alternative means on the basis of precise measures of

performance” (Jackson, 2005). MCDM, as one of the classical hard systems thinking, has advantages in dealing with well-structured decision problem in social system as follows:

(1) In the case of well-structured decision problems, methods like quantitative methods and mathematical models can help to clarify the problem structure. In addition, optimization can work effectively in simple systems, because for simple systems, optimal or ideal solution can be found in the decision space by optimization function, which help decision makers find satisfactory solutions eventually.

(2) Developed from single criteria models to multiple criteria models, MCDM has taken a large step in dealing with social system complexity. In addition, we must admit that with the rise of methods of Stochastic MCDM and Fuzzy MCDM, it has been able to handle some semi-structured decision problem, which indicates that its ability of coping with complexity of decision-making has been further improved. Although the mathematical models and quantitative methods have a natural defect, which lead to limitations in coping with complexity, but in the case of quantifiable attributes, and the structure is relatively clear (even if not entirely clear), MCDM methods can be a powerful tool, in such a case, it is even better than a lot of soft methods, including soft systems approach.

(3) Scheme searching and selecting are two equally important aspects in decision making, while multi-objective planning (linear programming, nonlinear programming, etc.) and multi-attribute decision making (AHP, ELECTRE, etc.) are complementary in these two aspects, thus making methodology more comprehensive. Furthermore, as a hard systems approach, MCDM is logical and verifiable, and with clear analysis steps and implementation steps, making it more applicable.

#### 4. SSM AND ILL-STRUCTURED HUMAN ACTIVITY SYSTEMS

Most of the human activity systems are not as clear as military or engineering systems and most of them are vague, complex and with ill-structure (Checkland, 1981, 1990, 1999; Yan and Yan, 2010; Yang, 2010; Zhang, 2010). They even appear that we cannot answer such simple questions: what systems the decision problem involved? What are the purposes of the systems? Actually it is usually difficult to describe the situation we faced with the term of “purpose”. Checkland cited an obvious example about the public agricultural policy of European Economic Community. There are three equally important objectives in this policy: (1) Increase agricultural productivity. (2) Ensure the employment of agricultural workers and agro-processing industry workers. (3) Provide consumers with good service. These three objectives are in conflict with each other, any of which can not overwhelm the others. How to balance these three incompatible objectives? Is MCDM strong enough to solve the problem? No matter how powerful its mathematical models are, we cannot obtain a satisfactory result, because this is essentially a political issue. It has to be submitted to the Parliament for deep discussion in order to reach a consensus, in Habermas’ words, this is a problem of discourse ethics, not an engineering technology or systems engineering problems. Therefore, as a hard systems approach, MCDM has its own limitations: When faced with ill-structured decision problems, the quantitative methods, formal methods and mathematical models cannot fully express the problem structure. Optimization cannot attain a reasonable solution either, any intention of insisting using optimization will eventually lead to oversimplification of the problem, furthermore, when comes to the diversity and conflict of worldview and values, it would be more difficult.

SSM is a response to the difficulty in applying hard systems thinking to ill-structured decision problems of human activity systems which are complex, fuzzy and pluralistic. Three characteristics of SSM are noteworthy:

(1) SSM is concerned about the problem situation but not the problem itself. That is because for some ill-structured problems, it is a problem that what system it should belong to. Therefore, different from hard systems approach, the first step of SSM is to build up the richest possible picture of the problem situation in order to make it clear rather than put the problem out too early. In addition, since most of the human activity systems have no well-defined objectives, SSM does not attempt to determine what the objectives are but to choose relevant human activity systems, prepare “root definitions” from these relevant systems, and construct the conceptual models. As a result, while hard systems approach leads to the design of systems, SSM leads to the implementation of agreed changes (Jackson, 2000).

(2) SSM lays great stress on the interpretation of pluralistic value of the system objectives. For a human activity system, different people have different interpretation on what the problem situation is, what objectives of the system should be achieved and how to improve the system. That is because people hold different weltanschauungs, world views and cultural backgrounds. SSM allows such a pluralistic interpretation. During interpret the system, SSM attaches great importance to the intervention of social, political and cultural factors, which reflected by the “two strands” version (Checkland and Scholes, 1990) of SSM. This model gives equal space to the culture stream of analysis and to the logic-based stream. Checkland stressed on the culture stream for he considers that “it plays a critical role in the human affairs” (Checkland, 1999).

(3) SSM is a learning cycle. As M. C. Jackson illustrated in his book *Systems Approaches to Management*, “The conclusion of the methodological cycle does not see a ‘solution’ to the original problem but merely emergence of another, different problem situation. Problem resolving in social systems is, for Checkland, a never-ending process of learning, in which participants’ attitudes and perceptions are continually tested and changed, and they come to entertain new conceptions of desirability and feasibility” (Jackson, 2000).

Moreover, we also need to note that MCDM developing from the classical paradigm towards the new paradigm of uncertainty, is going through a hard to "soft" process, and may have further trend of softening. We see in this process that the soften MCDM does have some concepts and characteristics of SSM, for examples, some problems of MCDM are also complex and fuzzy, without a good structure; with multiple objectives but not clear. Moreover, considering the philosophical foundation, multiple objectives are also permeated with the philosophy of value- pluralism. However, the difference between MCDM and SSM are also obvious:

(1) In order to cope with uncertainty, MCDM had weakened its normative and introduced the psychology behavior analysis of decision making, but the main weapons of which are still mathematical methods, only added other mathematical tools such as fuzzy sets, rough sets to make a more powerful mathematical team to cope with uncertainty. This is the essential difference from SSM. However, when faced the ill-structured problem situation, can these quantitative methods and mathematical models work? If they work, how much is the restriction? This is the limitation of quantitative approaches.

(2) Compared with the learning process of SSM, MCDM under uncertainty is an objective oriented linear process. Accordingly, their purpose is essentially different. SSM aims to explore possible changes and improve the problem situation, while MCDM aims to make the problem structured and establish the optimal decision-making model. MCDM under uncertainty still emphasis on logical thinking, problem solving is a mathematical solution process, while SSM stresses political, cultural and historical impact. In SSM, "the use of the word 'system' is no longer applied to the world; it is instead applied to the process of our dealing with the world. It is this shift of systemicity (or 'systemness') from the world to the process of inquiry into the world which is the crucial intellectual distinction between the two fundamental forms of systems thinking, 'hard' and 'soft.'" (Checland, 1999, P.A10)

(3) The MCDM under uncertainty, to some extent, had reduced the degree of difficulty of incommensurability of the attributes, but faced with the pluralistic values and world view, this approach has always been a quantitative compromise, but has no emphasis on "communicative rationality". Compared with SSM, it does not have a democratic process of debate involving a wide range of participants, and does not have an accommodation of interests, world view and values. Therefore, in the face of a conflict of interest involving multiple participants and a high degree of inconsistency in values, such as religious conflict, ethnic strife and competition of economic interests, MCDM becomes weaker.

(4) From the perspective of philosophical basis, methods of MCDM under uncertainty belong to objectivism and functionalism (Fan and Kuang, 2009), while SSM belongs to subjective constructivism and interpretation (Zhang, 2010).

## 5. SSM AND MCDM ARE COMPLEMENTARY

As a hard system method, MCDM has inherent weakness, however, this weakness does not mean that we have to abandon it completely. As Jackson said, during introduced "System Methodology System" (SOSM), "Previously, it had seemed as if the discipline was undergoing a Kuhnian 'paradigm crisis' as hard systems thinking encountered increasing anomalies and was challenged by other approaches. The SOSM, by contrast, demonstrated that alternative systems approaches could be seen as complementary rather than in competition" (Jackson 2005).

If the decision problems have well structure, that is to say, if the objectives and constraints are so clear that they can be expressed mathematically and exactly, the hard systems methodology is more suitable and advantaged. However, if the decision problems are ill-structured and difficult to express, the objectives of which are fuzzy, involving pluralistic values or value conflicts, we usually cannot use quantitative method at the beginning, so SSM is a good complementary methodology, because SSM helps decision-makers to improve the problem situation, which is also a process of making problem structured actually, but it is not executed by mathematical methods and it is not a linear process, but a learning cycle process. In such a learning cycle process, while encountered structural problems, in turn, the hard systems methodology is a complementary methodology to SSM. Here, we stress more how SSM is complementary to MCDM.

Firstly, when faced with semi-structured or unstructured decision problem, and the nature of the problem is not clear and the objective set cannot be obtained with certainty, optimization methods of MCDM cannot be used effectively, but SSM is able to guide the decision-makers to perceive the problem situation, to build and select a number of conceptual models by using systems thinking and to compare them to the practical problem situation, and to inspire people to discuss and debate in order to find desirable and feasible changes to help improve the problem situation, and then more structured problems can be processed with MCDM. For example, in the case of Foxconn, the problem situation is so ill-structured at the beginning that the managers even did not know what the problem exactly is (why so many suicides happened), not to say the objectives. In this case, SSM can help the staff to perceive and improve the problem situation, then various kinds of strategies can be produced through sufficient debate, and finally MCDM can be used to evaluate the different strategies.

Secondly, when faced with a conflict of interest involving multiple participants whose values are in a high degree of inconsistency, SSM is also a good complementary methodology, because it emphasizes the communicative rationality and the social interaction rationality, which enables an accommodation of different values and makes the purpose system clear. For example, in the project of chemical plant, we usually use MCDM to help choosing the location, but the problem is usually not so easy because it is faced with a conflict of interest and values, the essence of the problem may not which

location is the best in a city, but whether or not the chemical plant should be built. Xiamen PX event is a good example for this point and I think SSM can help managers to deal with such a problem.

Thirdly, SSM stresses cultural stream, attaching more importance to the political, cultural, historical impact, while MCDM emphasizes on logic, ignoring cultural thinking. The SSM users have to research the different models and different interpretations of the problem situation, in which the world view or culture basis has been reflected, then take three inspections: 1) check and analyze the intervention suggestion; 2) check and analyze the social system; 3) check and analyze the political system (Zhang, 2010). Then they can choose some culturally viable solutions to improve the problem situation. The supplement of cultural thinking is also the reflection of holism. It is very important to explore the broader social system behind the decision problem, in which the political and cultural systems are the subsystems cannot be ignored. The final example presented here is the city conservation work which is related to politics, economic and culture. For such a complicated work, quantitative methods are not sufficient and efficient, while SSM is a proper complementary method to them.

## 6. CONCLUSION

Social system has a dual nature. In dealing with the management complexity of social system, it seems that as if hard systems methodology and soft systems methodology are just two types of tension, of which the former tends to logical thinking while the latter tends to culture stream. Accordingly, the former mainly belongs to functionalism, while the latter mainly belongs to hermeneutic. MCDM, as a hard system approach, is strong in dealing with structured or semi- structured decision making problems of social system. However, in the face of many ill- structured problem situations in human activity systems, MCDM has its own limitations, while SSM can be a complementary methodology to MCDM. The combination of MCDM and SSM can strengthen the ability of dealing with complexity of social system. However, this study is just for the theoretical assumptions, the concrete combination model of MCDM and SSM and its inspection in specific cases still needs further research.

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