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# ANALYSIS AND MODELLING OF COMPLEX DECISION SITUATIONS

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## Abstract:

This paper suggests specific logical ideas that lead to scientific analysis and building implementable models for complex decision situations that arise in modern organizations. These models should be easily understood and applied by decision makers in a changed system environment with multiple objectives.

**Keywords**: Decision, Modelling, Analysis.

## 1. Introduction:

Complex Decision Situations (CDS) arise in many industrial, business and other organizations. In these situations, participants have a wide range of conflicting objectives.Optimization techniques of decision making may have limited use in the resolution of CDS.[2] Decision makers who encounter CDS which do not have well-defined boundaries often deal with them by using intuitive methods based on experience .

System complexity may arise from interactions of the system with its observer/regulator rather than an intrinsic property of the system itself. Therefore, given a set of alternatives in CDS , each with multiple attributes, the question is which one will be chosen by a certain individual or group of decision makers .Such question could not be easily answered, and the consequences of its response make significant impact on policy makers in different organizations.However, managers should choose a course of action which allow them greatest control over events in the period between the moment of making a decision and the time when the actual results of the decision become known.

## 2. The main features of complex decision situations cds:

CDS have the following characteristics:

**1.** Incomplete Information: The information available to Decision Makers (DM) involved in a CDS is usually incomplete. This requires data collection which takes time and effort. Incomplete information prevents the development of an effective model of the CDS because of uncertainty about many parameters that affect the choice of courses of actions.

**2.** Different preferences of participants: In many CDS participants have different preferences which affect the resolution of CDS.

3. Conflicting Objective in CDS, any course of action that gives maximum achievement of one objective may effects other objectives.

**4.** CDS are not amenable to treatment by a formal analytical procedure incorporating a process of optimization.

**5.** As more information about the CDS is garnered, different alternative courses of action may become apparent.

**6.** CDS environment is dynamic and made up of social, technological, and natural elements that affect the feasibility of alternative courses of action.

## 3.Complex decision situations 'systems:

CDS exist in complex systems which constitute a number of subsystems interacting through many feedbacks –feedforward loops. According to Beer [3], such systems are called 'Viable Systems VS' as shown in figure (1).

Inspection of figure (1) will show five interacting subsystems labelled ONE, TWO and so on, in capital letters. Among these may be discerned two systems ONE, each of which contains a complete Viable System displayed at a 45 degree angle.Beer [3] states that the embedded Viable Systems are shown as interacting in exactly the same way with local environments that are peculiar to each of them – although they are (inevitably) subset of the whole – page environment.

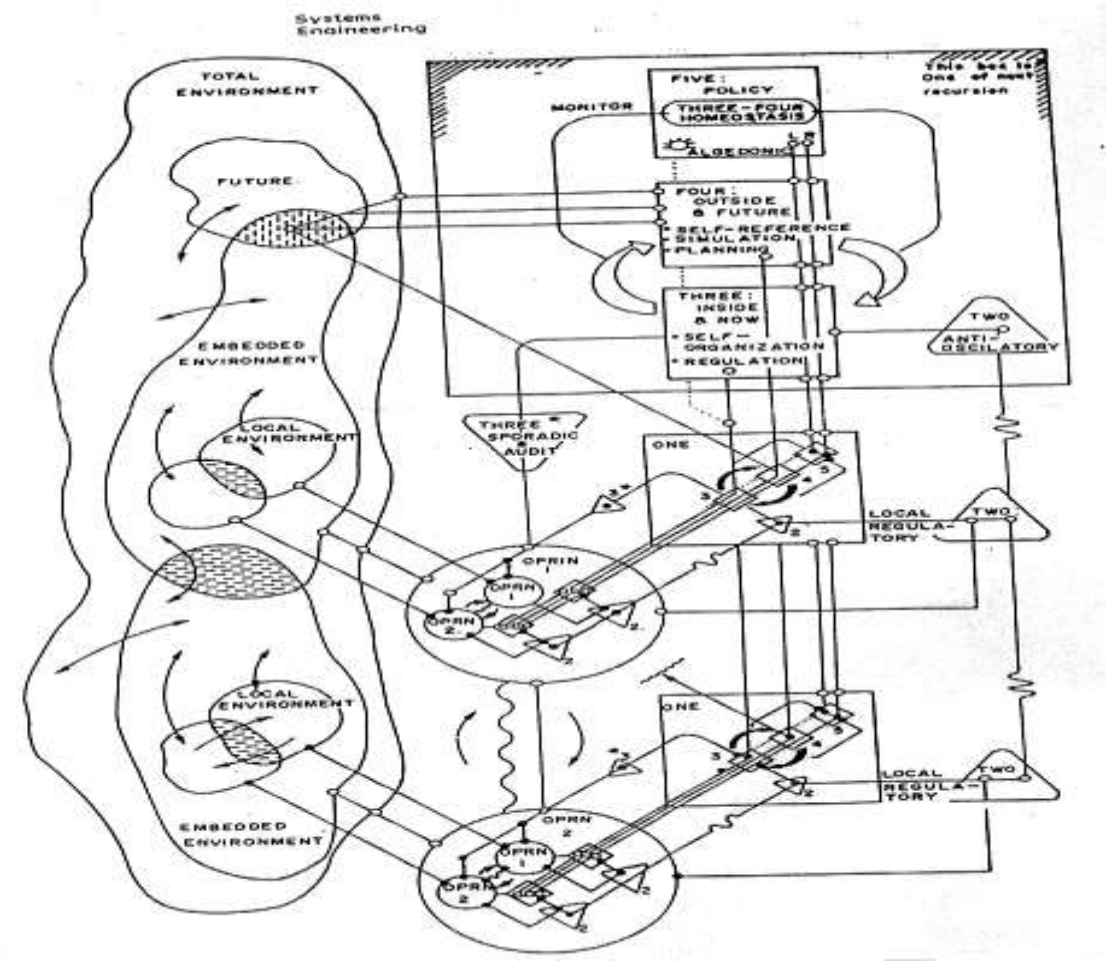


Figure (1): The Viable System [3]

## 4. Decision making process in cds:

The essence of decision making in CDS is the formulation of alternatives and the subsequent choice between them.The concept of'decision' contains five components and three types of parameters. [2] The components are: the decision maker, the available course of action, the possible outcomes of the courses of action, the environment and the constraints. The parameters are: the probabilities of choice, the efficiency of each available course of action and the relative value of each outcome.

Figure (2) presents a conceptual model of the decision making process. We note that it contains the same essential steps involved in the systems engineering process.

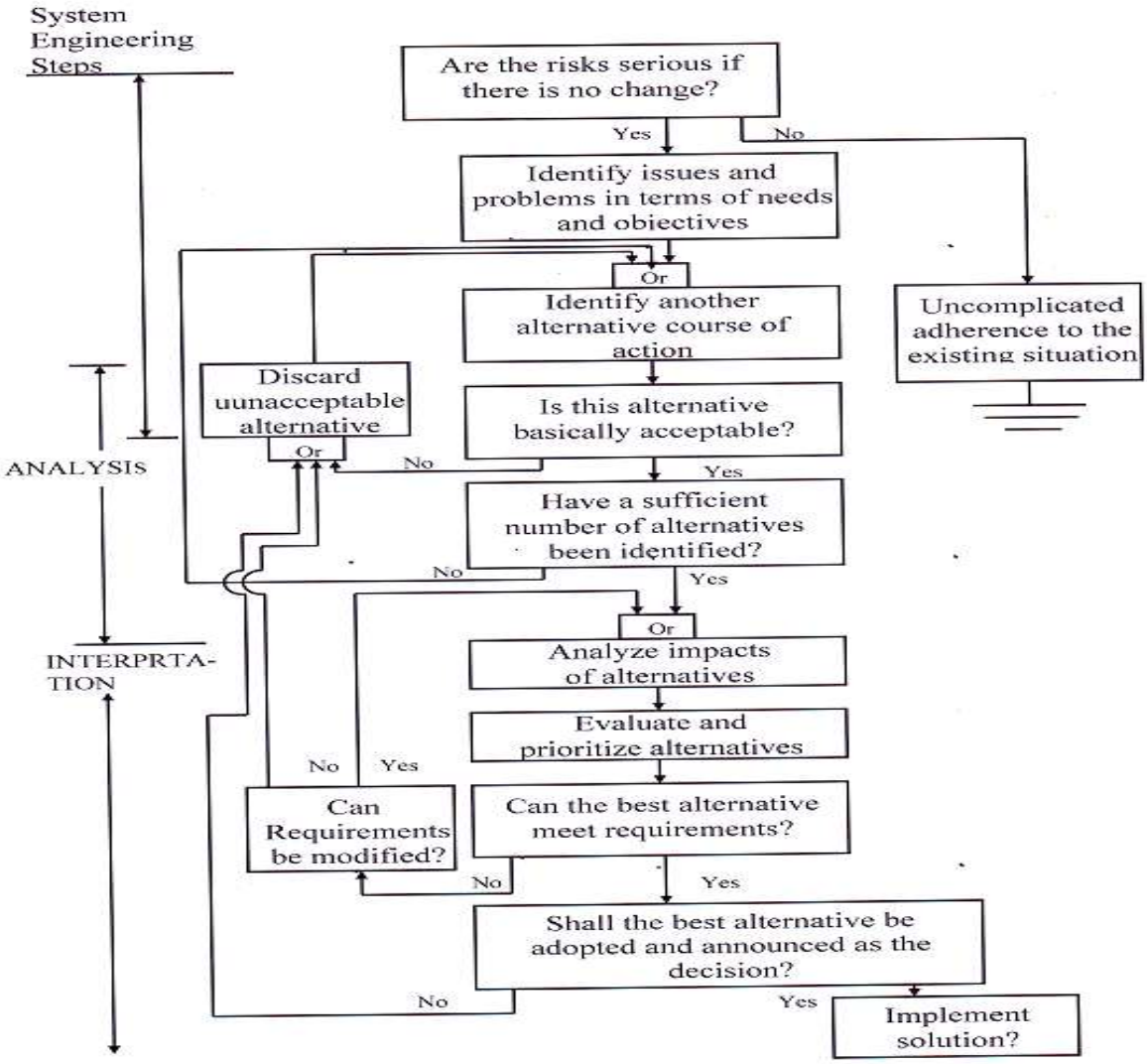


Figure (2) The Decision making process [2]

CDS are not governed by clear decision goals established at the start of the process. Therefore, the problem solving process of CDS is rather accompanied by a goal searching process, which when completed too late serves only to justify the decisions already made under goal uncertainty. However, the goal searching process can have some guiding impact on the decision making process.

## 5. Analysis of complex decision situations:

The process of analysis of CDS must lead to a rational decision structure that yields adequate decisions. The greater variety of information available, the greater will be the range of alternatives that can be readily acceptable to those responsible for the resolution of CDS.

This paper suggests the following logical guidelines for the analyst involved in the resolution of CDS.

1. Study the CDS environment carefully and identify all possible Constraints.
2. List all participants and their preferences.
3. List all possible courses of action.
4. Specify a performance measure which provides the basis for determining how a particular course of action is to be judged.
5. Avoid uncertainty by gathering as much information as possible.
6. List all objectives and identity the DM preferences as to these objectives.

## 6-Modeling complex decision situations:

### 6.1-The Model Building Process (MBP)

The concept of 'Model' is widely used in OR and many other disciplines.The model is an abstraction of things thought to be important in a real life situation. [1]

The Model Building Process (MBP) is both an " art " and " Science " . It needs a closer user involvement especially when dealing with CDS. Figure (3) shows the MBP and its interaction with the real world. [4]

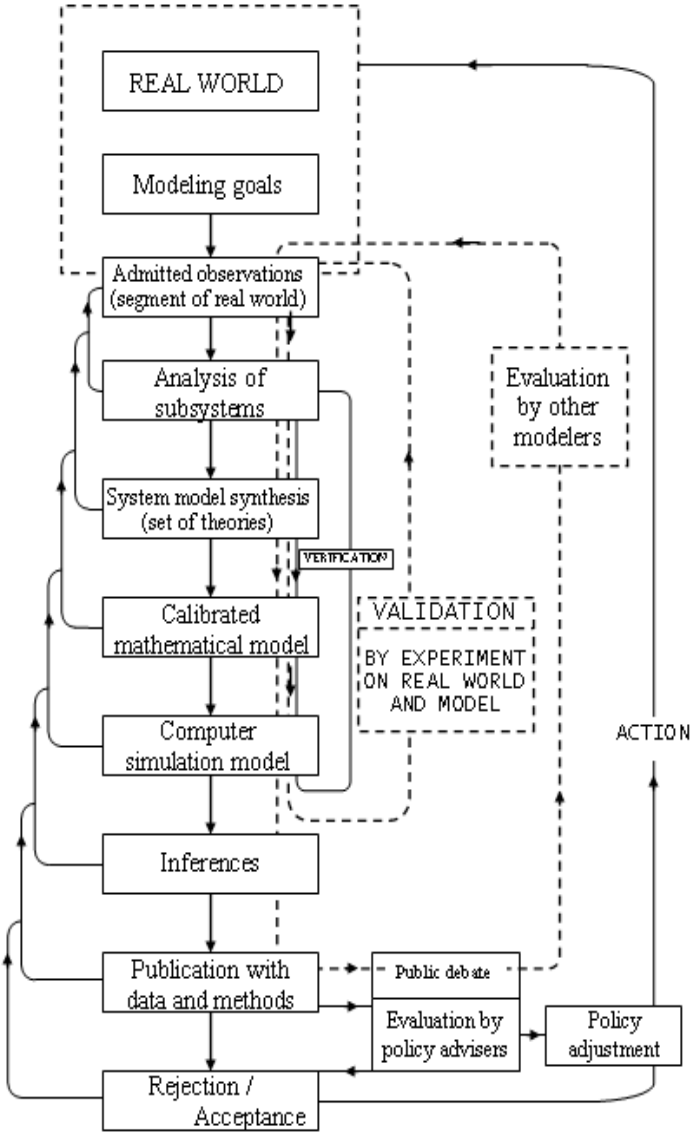


Figure (3) .The model building process and its interaction with the "real world"[4]

Among the various issues that the model builder has to concentrate on in building and improving his model, are **"Verification"** and **"Validation "**. Verification is to test the model output against results of another known cases. . Validation is to test the agreement between the model and the actual system behavior.

**6-2.Modelling CDS**

The fundamental motivation of this paper is to suggest the following logical ideas for building any complex Decision Situation model (CDSM)

1. Since the Decision Situation (DS) must exist in a Real Life System (RLS), Let us assume that the RLS complexity as perceived by the Decision Maker

$$C_{DM}^{(RLS)} .$$

2. From the point of ivew of the RLS, the DM is also a system with its own complexity

$$C_{RLS}^{(DM)} .$$

3. Logically, the RLS and the DM interact. Hence the relationship between the quantities

$$C_{DM}^{(RLS)} \text{ and } C_{RLS}^{(DM)}$$

provides a basis for CDS modelling .

4. The model must provide balance between

$$C_{DM}^{(RLS)} \text{ and } C_{RLS}^{(DM)}$$

5. The CDSM should minimize the uncertainty between the actual results and the outcome predicted at the time of making a decision.

6. The CDSM should be **easily understood** and applied without constant analyst intervention.

7. The CDSM should be **adaptive,** i. e., can be applied in a changed system environment**.**

8. The CDSM should provide only an **incremental change** in the CDS. The DM may abandon the principle of **optimization** and the search for the **"best"** course of action.

## 7-Conclusions:

1. The analyst who is involved in the resolution of CDS have to take the following important issues into his consideration:
   - A sufficient knowledge about all possible courses of action and participant preferences.
   - Understanding of all DM objectives.
2. CDS cannot be modelled feasibly by tranditional optimization models because their systems parameters are too difficult to obtain.
3. Complex Decision Situations Models (CDSM) can be valid and implemented if they satisfy certain characteristics such as:

-Balance between

$$C_{DM}^{(RLS)} \text{ and } C_{RLS}^{(DM)}$$

- Uncertainty minimization.
- Easily understood by DM.
- Adaptive and lead to incremental changes in CDS.

## Abbrveiations:

CDS complex Decision Situations

| | |
|---|---|
| $C_{RLS}(DM)$ | Complexity of the Decision Maker as perceived by the Real Life System |
| $C_{DM}(RLS)$ | Complexity the Real Life System as perceived by the Decision Maker. |
| $CDSM$ | Complex Decision Situation Model |
| DM | Decision Maker. |
| MBP | Model Building Process. |
| OR | Operations Research. |
| RLS | Real Life System. |
| VS | Viable System. |

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# تحليل ونمذجة حالات القرار المعقدة


نجاح رسول

كلية العلوم – جامعة ذي قار



## المستخلص:

الهدف من هذا البحث هو اقتراح أفكار منطقية محددة تؤدي إلى تحليل علمي وبناء نماذج قابلة للتطبيق في حالات القرار المعقدة التي تظهر في المؤسسات الحديثة .هذه النماذج يجب أن تكون سهلة الفهم والتطبيق من قبل صانعي القرار في بيئة المنظومة المتغيرة ذات الأهداف المتعددة .