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MODELING DECISION SUPPORT SYSTEMS

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Abstract:
The military system has developed constantly and has remained connected to everything that means the decision-making process, At the same time, to reduce operating costs, simulators have made their way into all categories of forces. An important place is occupied by intelligence; it has developed both by volume and by means of collection, which has led to the design of computer systems for collection, transmission and analysis. Different integrated operations and information systems, now offers a wide range of functionalities especially in operations, command and control forces.The benefits of implementing the decision-making process using models and decision support systems provide an extensive understanding of situations, a developed process in solving problems and reach a decision. The problem of real-time decision-making process is a current challenge to the decision makers and to the artificial intelligence.

***Key words**: decision, making, framework, challenges*

1. Introduction

Decision makers need a framework that constantly adapts to an organization conditions or to the new challenges of the ever-changing organizational environment. Information management and decision making within an organization requires a systematization of the problem, a model and a decision support system. For this situation, the decision support system (DSS) combines human skills with the skills of PCs. to provide productive information management, reporting, investigation, display and troubleshooting. This approach seeks to make a synthetic connection between the steps of the decision-making process, the creation of a model and the decision support system.

2 Decision-making process

2.1 Decision-making process steps

Decision-making can be defined as the process of selecting a right and effective course of action from two or more alternatives for the purpose of achieving a desired result. Decision-making is the essence of management. The entire managerial process is based on decisions. Decisions are needed both for tackling the problems as well as for taking maximum advantages of the opportunities available. Effective decisions reduce complexities, uncertainties and diversities of the organizational environments.

The decision-making process is a tool available to any manager, at any level, to choose the optimal, deliberate and thoughtful decision. This process is done by collecting and organizing relevant information and prioritizing alternatives. This approach considerably increases one's chances of choosing the most satisfactory alternative. "Decision making has always been a difficult process, based on various combinations of objectivity (when scientific tools were used)

and subjectivity (considering that decisions are finally made by people, with their strengths andweaknesses)."[1]

Step 1: Identify the decision

Identifying the decision is the first step in this process, which is very important in clearly defining the nature of the decision that should be made.

Step 2: Gather relevant information

The collection of information must take into account the following aspects: knowing what information is need and having a plan for gathering information from credible sources. The information come from internal source or external sources. External information can be found online, from open sources or from other people. Additionally, it's important to note, that in some case the collection process involves spending large sums of money and resources to obtain a good information.

Step 3: Identify courses of action

The information obtained creates alternatives, courses of action. Their identification and listing will be done at this stage of the decision-making process.

Step 4: Weigh the evidence

Analyze each course of action, weigh the pros and cons. Assess at this stage whether the need identified in step one is met or addressed through each course of action. Some alternatives have a higher potential to achieve the goal. Sort the alternatives according to the established criteria.

Step 5: Choose amongst alternatives

Once all available data has been considered, the best course of action will be chosen. Alternatives can be combined into a new one. The alternative chosen in this step may be the same or similar to the alternative at the top of the list in step four.

Step 6: Take action

In this stage, we move on to the implementation of the course of action chosen in step five.

Step 7: Review your decision and its consequences

At this point, consider whether the resulting decision meets the need set up in step one. If the decision did not meet the identified needs, certain steps in the process may be repeated to make a new decision. For example, if the initial information changes, then additional information will be needed.

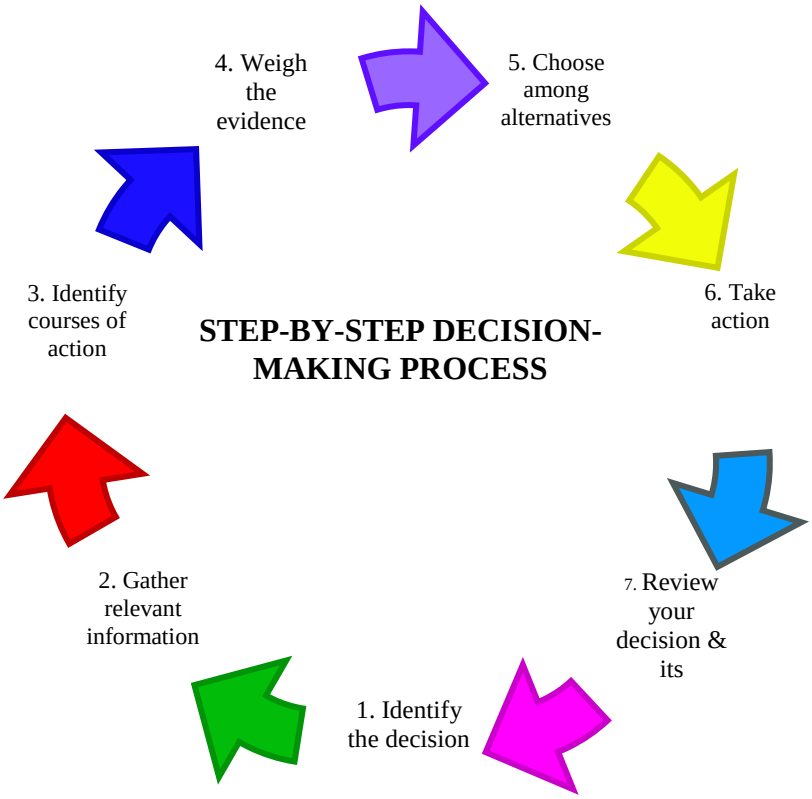

Fig.1 Step-by-step Decision Making Process

MDMP (Military Decision Making Process) uses the same steps, with small changes in problem solving and decision-making. It applies at all echelons and includes the steps needed to develop well-reasoned, supportable solutions.

Ref: ATTP 5-0.1, Commander and Staff Officer's Guide (Sept '11), pp. 11-1 to 11-6.

1. Identify the Problem
2. Gather Information
3. Develop Criteria
4. Generate Possible Solutions
5. Analyze Possible Solutions
6. Compare Possible Solutions
7. Make and Implement the Decision

3. Model construction

3.1 Model construction

A model is a simplified and small-scale representation of the real world and includes only some of the relevant variables to the problem at hand. The oldest models were physical

representations, such as ships, planes and wind tunnels. Physical models are usually quite easy to build, but only for relatively simple objects or systems and are usually difficult to change.

The next model, the graphic, is used for only three variables, is easier to build and manipulate, but more abstract.

To represent several variables is necessary to use symbolic models. These are completely abstract without any limit on the number of variables that can be included.

The model is given content or meaning by defining the symbols. This makes the symbolic models of the system with very different content often reveal a similar structure. Therefore, most systems and the problems that arise can be successfully classified in terms of relatively few structures. Because the methods for extracting solutions from models depend only on their structure, some methods can be used to solve a wide variety of contextual problems. Finally, one system that has the same structure as another, no matter how different the two in content, can be used as a model for the other. Such a model is called analog. By using such models, much of what is known about the first system can be applied to the second.

Physical and graphic models are frequently used in the preliminary phases of constructing symbolic models of systems.

Models represent the causal relationship between the controlled and uncontrolled variables and system performance; they must therefore be explanatory, not merely descriptive. Only explanatory models can provide the requisite means to manipulate the system to produce desired changes in performance.

Models are also are useful in formulating the problem not only assist in finding the answer. Models can be used as guides to explore the structure of a problem and to reveal possible courses of action that might otherwise be missed. In many cases the best course of action revealed by such application of a model is so obviously superior to previously considered possibilities that justification of its choice is hardly required.

In some cases the model of a problem may be either too complicated or too large to solve. It is frequently possible to divide the model into individually solvable parts and to take the output of one model as an input to another. Since the models are likely to be interdependent, several repetitions of this process may be necessary.

Even if a model cannot be solved, and many are too complex for solution, it can be used to compare alternative solutions. It is sometimes possible to conduct a sequence of comparisons, each suggested by the previous one and each likely to contain a better alternative than was contained in any previous comparison. Such a solution-seeking procedure is called heuristic.

3.2. Testing the model and the solution

A model may be deficient because it includes irrelevant variables, excludes relevant variables, contains inaccurately evaluated variables, is incorrectly structured, or contains incorrectly formulated constraints. Tests for deficiencies of a model are statistical in nature; their use requires knowledge of sampling and estimation theory, experimental designs, and the theory of hypothesis testing.

The structure of a model consists of a function relating the measure of performance to the controlled and uncontrolled variables; for example, a business may attempt to show the functional relationship between profit levels (the measure of performance) and controlled

variables (prices, amount spent on advertising) and uncontrolled variables (economic conditions, competition).

The solution derived from a model is tested to find whether it yields better performance than some alternative, usually the one in current use. The test may be prospective, against future performance, or retrospective, comparing solutions that would have been obtained had the model been used in the past with what actually occurred. If neither prospective nor retrospective testing is feasible, it may be possible to evaluate the solution by "sensitivity analysis," a measurement of the extent to which estimates used in the solution would have to be in error before the proposed solution performs less satisfactorily than the alternative decision procedure.

3.3. Military models

The evolution of models from the classic sandbox to the 'Holographic Tactical Sandbox' is a big loop that facilitate operational planning and decision-making. In addition to its operational benefits, this lightweight, ergonomic and compact technology offers several other advantages:

- Remote tactical planning: Thanks to an avatar, military leaders can meet around a holographic map even if they are not in the same base.
- Improvement of the battlefield perception: Augmented reality allows players to experiment the battlefield in advance. They can feel and anticipate the main sensitive military data (planimetrics, intervisibility, covered infiltration tracks, etc.)
- Time-saving: No tedious sandbox to build. Digital maps easy to load in the system.

4. Decision support systems (DSS)

Computers have had a intense impact on the management systems and in different fields. The capabilities of computers, speed and data-handling allow scientists and military to construct complex and realistic models of different organized systems and to get solutions from simulation techniques.

The primary use of computers have been in the areas of record keeping, bookkeeping, and transaction processing. These programs, were oriented to maintain orderly and accurate records.

After a while, computers entered in the basic decision-making process offering a tool to decision makers. Evolution from data-processing systems to prepare management summaries is call management information systems (MIS). These systems use to keep inform the managers, to monitor on trends, cycles and performance.

Recently, decision support systems (DSS) receive the new functions to project and to predict the decisions before they are made. These functions allow managers and analysts to evaluate the possible effects of decisions and to find alternatives.

The development of decision support systems can be found in different fields, from military to business planning. To create a computer-based systems is necessary to combine knowledge of an organization and its activities, to technical skills in computer programming and data handling.

4.1 New software tools for decision making

The availability of Microsoft Office or similar programs on personal computers, with their capabilities, makes a big step forward in construction, solution, and testing of models. Easy-to-use programs permit for collaborative work, easy communication with analysts and managers and finally a low-cost model building. Now, all the managers use computers in their daily work with programs as a part of their managerial duties.

4.2. Examples of Decision Support Systems

The first step to solving a problem is finding out its common structure. The most common structures have been identified as prototype problems, and extensive work has been done on modeling and solving them.

All the problems with similar structures can use the same model. Large or complicated problems can be divided in smaller solvable problems. The overall model is a aggregation of different prototypes from smaller problems.

Resource allocation

Allocation of resources among different alternatives will be done in a manner to maximize the profit and reduce the cost. The problem is how much the resource will be allocated to a set of jobs.

Linear programming

Linear programming (LP) refers to solving resource allocation problems, use mathematical optimization techniques, in industrial production systems.

Linear programming is probably the most widely used mathematical optimization technique, numerous computer programs are available for solving LP problems.

Inventory control

Inventory control is used in order to optimized the stocks and reduce the cost. Another role of the general inventory problem is to trigger the time and the levels at which orders for replenishment of inventories are to be initiated.

Japanese approaches

In the 1970s several Japanese firms, led by the Toyota Motor Corporation, developed approaches to the management of inventories named "just-in-time" approach. The element of the new systems was reduction of inventories throughout the total production system. This approach needed a very good coordination of resources. They develop the method using cards or tickets attached to the goods making the system running very simply, the total number of parts in the system is held constant, the coordination, scheduling, and control of the inventory is greatly simplified. This technique is called Kanban.

Replacement and maintenance

Replacement and maintenance problems involve items or some parts that degenerate with use or with the passage of time. To find out the right time and the right quantity of items that must be replace in order to reduce the total cost.

Queuing

A waiting line process that deals with items or people in sequence. The cost of providing service and the waiting time of users are minimized.

Job shop sequencing

Is a more elaborated queuing, that means to find the right job and the right moment to maximize the profit and reduce the cost. Selection of order to minimize some function of the time to perform all the tasks is a sequencing problem.

Manufacturing progress function

Increasing the production of different goods, while decreasing their manufacturing costs in predictable fashion. Declining steeply at first, and then continuing to decline at a lower rate. In this case, the estimating future costs will be valuable.

.**Network routing**

A network routing problem consists of finding an optimum route between two or more nodes in relation to total time, cost, or distance. Taking in account the problems that exist, such as a prohibition on returning to a node already visited or a stipulation of passing through every node only once.

Competitive problems

Competitive problems are applicable also to the military decision making process because the outcome of one decision maker's choice depends on the adopted solution. Competitive problems can be certain, risky, or uncertain. Under certain condition it is easy to make a decision, but under the risk or uncertain conditions it is recommendable to use analysis or estimations in order to choose the best alternative. This can be used in business for contract competition.

The theory of games was developed to deal with a large class of competitive situations of the uncertainty type in which each participant knows what choices he and each other participant has. The military have long constructed operational games; their use by business is more recent.

Search problems

Search problems involve finding the best way to obtain information needed for a decision. Military problems involving composition, location and intentions of the enemy forces.

Observation can affect the decision if it is made with error, omit or commission,

The cost of search can be controlled if it is orientated in the right spot and at the right time.

A "reversed-search" problem arises when the search procedure is not under control but the object of the search is.

Militaries are increasingly bringing simulators into their training programs to cut down various operating costs associated with the training involved with real equipment. Moreover, many governments are planning on shifting parts of their trainings and using simulators.

The modernization of armed forces has lead to an increased demand for military-simulator systems around the world.

Different platforms offer an integrated operations and information system, which offers a wide range of functionalities specially designed to meet the requirements of multi-national forces and joint service commands. That have been designed and developed to be operated in mobile as well as in static headquarters. It perfectly suits modern types of operation and task management at all command and control levels. The features are:

- Built-in Multilateral Interoperability Programmer (MIP) standard data model and extensions;
- Interfaces to tactical communication links;
- Comprehensive set of operational applications (Transfer of Function Orders (TFO), battle space monitoring, planning management, Rules of Engagement management, intelligence, services, logistics…)
- Full collaborative environment (web, messaging, chat, access management…)

- Personnel data maintenance and retrieval
- Order of Battle management
- Data access and filtering, request tools
- Situation display integrating a large range of cartographic formats with compiled Situation
- Layers including real-time tracks
- Logistics data maintenance and retrieval, management tools
- Live, simulation and exercise mode of operations
- MIP compatible data exchange

5 Conclusion

Decision makers supported by their staffs, use the operations process to drive the conceptual and detailed planning necessary to understand, visualize, and describe their operational environment. Take the beast decisions and direct, lead, and assess military operations.

The military system has developed constantly and has remained connected to everything that means the decision-making process,

At the same time, to reduce operating costs, simulators have made their way into all categories of forces. An important place is occupied by intelligence; it has developed both by volume and by means of collection, which has led to the design of computer systems for collection, transmission and analysis.

Different integrated operations and information systems, now offers a wide range of functionalities especially in operations, command and control forces.

The benefits of implementing the decision-making process using models and decision support systems provide an extensive understanding of situations, a developed process in solving problems and reach a decision.

In my opinion, the problem of real-time decision-making process is a current challenge to the decision makers and to the artificial intelligence.

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