2000

Development of Integrated Decision-Making Support Systems: A Practical Approach

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Abstract

Integrated Decision-Making Support Systems (IDMSS), are specialized Computer Based Information Systems designed to support all phases of the Decision-Making Process. Full integration of stand-alone components was proposed in the early 90´s and, despite substantial reported benefits above less integrated systems, few of the fully integrated systems have been implemented in practice. We believe that this "implementation paradox" is caused by the lack of a process-oriented perspective to guide the implementation of IDMSS. This tutorial has the goal of offering such a process-oriented approach.

Introduction.

Integrated Decision-Making Support Systems (IDMSS), also called Management Support Systems (Turban, 1990a) or Decision Technology Systems (Forgionne, 1991), are specialized Computer Based Information Systems designed to support all phases of the Decision-Making Process. Since their introduction in the early 90's (Turban and Watson, 1989; Forgionne, 1991) and despite their demonstrated superiority to the less integrated systems (Forgionne and Kohli, 1995), there are still few implementations of fully integrated system in practice.

At present, research on DMSS implementation has focused on general guidelines dealing with organizational, system, technical and user factors (Mora et al, 2000a). Few studies have addressed a process-oriented perspective to guide the implementation of IDMSS (Mora & Padilla, 1998; Saxena, 1991; Forgionne, 1999; Mora et al, 2000a). We believe that this difference in orientation is the main barrier to successful IDMSS implementation. This tutorial will demonstrate the linkage and propose a model for alleviating the problem.

Decision-Making Process and Decision-Making Support Systems.

Core concepts of Decision-Making Process.

The Decision-Making Process (DMP) can be defined as the steps developed by a decision-maker to identify a problem, propose and evaluate alternative solutions, select the most preferred alternative, and finally implement the choice (Simon, 1960; Ackoff, 1962; Huber, 1986; Sage, 1980). Both private and public sector decision-makers will perform this process. The Nobel laureate Herbert A. Simon has pointed out that the organizations of the post-industrial society will be more concerned about the DMP than with any other managerial activity (Simon, 1997).

Simon's Classic DMP and a New General DMP.

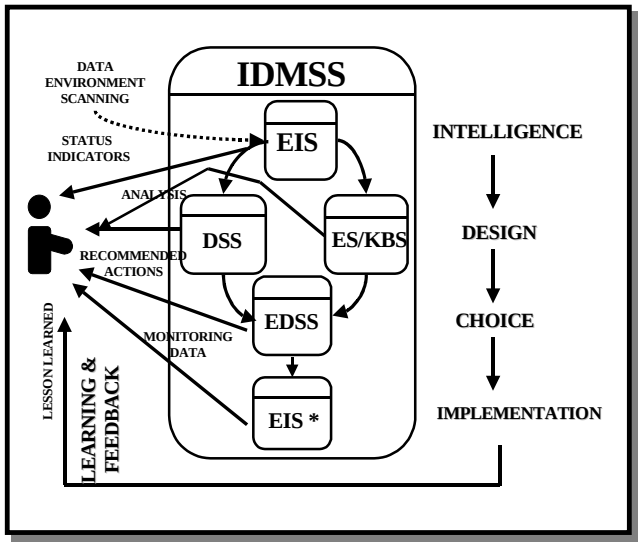
A general DMP model, which is an adaptation of Simon's Model, can be described through the following 5 phases (Forgionne and Kohli, 1995; Mora et al; 2000b):

- Intelligence. An organizational problem or opportunity that requires a solution is identified. Also, a set of quantitative and qualitative data pertinent to the problem is gathered, and a relevant decision problem or opportunity is identified.
- Design. A model of the decision situation is formulated or structured, with this model consisting of action alternatives, uncontrollable events, and associated outcomes and evaluation criteria.
- Choice. Alternatives are evaluated in terms of their contribution to the outcome, and the action is selected that best achieves the decision objectives.
- Implementation and Monitoring. There is a commitment of financial, human and material resources in a implementation plan. Also, monitoring activities to control the implementation of the decision are developed.
- Learning and Feedback. Learned lessons from the effects caused by the implemented decision are implicitly or explicitly recorded in the organizational memory (Cyert and March, 1963; Drucker, 1967).

Technical Architectures of IDMSS.

Integrated Decision-Making Support Systems (DMSS) are designed to support all phases of the DMP. Figure 1 shows an IDMSS technical architecture linked to the DMP.

Figure 1. Technical Architecture of IDMSS .



Such a system offers users the following capabilities (Mora et al, 2000b):

- Visual Data Exploring. The user can perform visual analyses using graphs, color codes and tables. Also he/she can perform data exploration with drill-drown, roll-up, slice and dice, and pivoting operations.
- Numerical Modeling. The user has available numerical-based models to do what-if, goal-seeking and sensitivity analysis of decision variables.
- Symbolic Reasoning. The user has available knowledge-based models that can do symbolic inferences to solve a problem and explain how and why the solution was reached.
- Intelligent Advice. The user has available all the previous capabilities such that the system delivers advice based on numerical and qualitative models of the decision problem.

A Practical Development Framework for IDMSS.

Process, Phases and Steps of an Outcome-Based Decision-Making Model.

While some phases, or some steps within phases, may be performed concurrently, decision making fundamentally is a sequential process. Design will require intelligence. Choice should not precede without design. Implementation follows choice.

Since an outcome from the decision can occur only after the final choice has been implemented, the decision outcome will be a function of (largely explained by) the decision-making process. There can be an outcome to the organization (for example, improved performance) or the decision-maker (for example, learned skills and abilities) (Forgionne, 1999).

The decision making process can be defined as the set of its phase activities, and each phase can be defined as the set of its step activities. All of these relationships can be defined as functions and sets, with the functions and sets establishing a link between the decision making process and decision outcomes. This decision-theory-based link model shows how the process affects outcomes to the decision-maker and organization. In addition, the model's phase and step breakdown helps to isolate the specific causes for particular decision outcomes.

Description of Potential Applications.

The process-outcome link model can be applied to traditional management problems in finance, marketing, production, human resource administration, and accounting. There are also applications in military housing, public finance, and health care management. Most of the applications will be focused on ill-structured strategic problems facing top-level (or executive) decision-makers. The next section presents one such application.

A Practical Demo-Case.

One recent application demonstrated how an IDMSS could improve the outcomes from, and the process of, strategic hospital decision making (Forgionne and Kohli, 1995). In this application, the decision-maker utilized available information with her/his experience, judgement, and knowledge to develop a hospital policy that would generate as much return on revenue (ROR) as possible. The system delivered decision-specific information and knowledge about some controllable inputs and some complex environmental forecasts.

Organization (hospital) performance was measured by the absolute difference between the observed return on revenue and the 6% midpoint of the industry standard. Decision-maker maturity was assessed by the decision maker's effort expended on, and capability in, defining the management problem, exploring the interpretation's relationship to alternative views, and generating alternative clinical and administrative solution concepts. Effort was measured by the time (in minutes) spent on the decision making. Capability was assessed with the numbers of opportunities and problems identified, and the number of alternatives generated, during the decision-making.

Outside experts used their experience, judgement, and knowledge to rate the decision maker's ability to perform each of the four general phases of decision-making -- intelligence, design, choice, and implementation. Self-ratings assessed the usefulness of the system in supporting the decision-maker's ability to perform the steps within the phases.

IDMSS users improved the performance of the organization, generated a larger number of alternatives, and increased decision effort. According to the outside experts, system users also had improved performance on the intelligence, choice, and implementation phases of decision-making. The users themselves felt that the system improved their ability to recognize the problem or opportunity, generate alternatives, evaluate alternatives, and choose the final alternative. In addition, they felt that the system was effective in supporting the hospital decision making process. These results support the general finding that the integrated decision making support system results in superior outcomes from, and an improved process of, hospital decision making.

Review of Research and Practice on Implementation of IDMSS.

Status of Research and practice on IDMSS.

Research has provided necessary conditions to attain a successful implementation of EIS (DeLong and Rockart, 1986; Guiden and Ewers, 1988; Barow, 1990; Watson et al, 1991; Srivihok, 1999), DSS (Liang, 1986; Sanders and Courtney, 1985; Alavi and Joachiminsthaler, 1992; Guimaraes et al, 1992; Finlay and Forghani, 1998), and ES/KBS (Meyer and Curley, 1989; Turban, 1990b; Tyran and George 1993; Guimaraes et al 1996). This research has focused on general organizational, system, technical and user guidelines (Mora et al, 2000a). Few studies have addressed a process-oriented perspective to guide the implementation of IDMSS (Mora & Padilla, 1998; Saxena, 1991; Forgionne, 1999; Mora et al, 2000a).

Problems and Challenges of IDMSS Implementation.

Special user characteristics, the complexity of the decision problem situation, the non-standard technical tools and technical skills of personnel required to develop fully integrated systems, and lack of user awareness are potential barriers to successful IDMSS implementation. Perhaps these barriers account for the paucity of reported applications. If so, the main challenges to implement IDMSS in organizations are to promote top management awareness of IDMSS potential, to educate and train technical staffs in DMP and IDMSS, to initiate small exploratory projects in relevant applications, and to make available suitable software development tools.

Recommendations for Research and Practice.

For research, we suggest changing the focus of the studies from the current factor approach to the suggested process-oriented perspective. More case studies will be needed to identify the nature of the full implementation process in successful organizations. Studies about management and technical development methodologies are also missing. For practitioners, we encourage business organizations to explore IDMSS through the development of small but relevant projects. At present, there are inexpensive development tools available to initiate small and medium size projects. Also we encourage IT professionals to participate in training programs offered mainly by universities and research centers. Commercial seminars are also useful, but it is important for the practitioner to acquire a basic knowledge of DMP and IDMSS as a prerequisite to a full understanding and appreciation of the specific development tools.

Conclusions.

Decision-Making is a crucial managerial activity. In today's complex and dynamic business environment, support will be needed for all phases of this process, especially for top level managers. Existing standalone systems offer partial, non-integrated support for the DMP, while IDMSS has the power to overcome these support deficiencies. For such power to be realized, an effective design and development strategy will be needed to avoid the "implementation paradox". We suggest a process-oriented model that focuses on the necessary link between the decision process and outcome. By utilizing this approach we believe that practitioners can reap the same rewards reported in the few implemented IDMSS.

References.

A complete reference list, along with a longer version of the paper, is available from Professor Mora.