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Managing Institutionalization of Strategic Decision Support for the Egyptian Cabinet

HISHAM EL SHERIF

*The Management Department
The American University in Cairo
113 Kasr El Aini Street
Cairo, Egypt
and
Information and Decision Support Center
Cabinet of Egypt*

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Our approach to managing institutionalization has evolved from the implementation of 28 large projects in Egypt. The projects were part of a program initiated by the Cabinet of Egypt late in 1985. The aim of the program is to improve strategic decision making at the cabinet level. Projects were driven by macro strategic issues or needs for management and technological development in establishing decision support systems (DSS) in different ministries, sectors, and governorates. The systems supported debt management, public sector performance evaluation, customs reform, energy pricing, and general performance administrative decision making. Our experience with the introduction, development, and use of these systems suggests that managing institutionalization is as important as model building. It should be an explicit, complementary, and integrated process that accompanies system development and model building.

Improving strategic decision making can have enormous impact on the effectiveness of organizations, industries, and national strategies. The accumulated literature on practice and implementation generally suggests that the appropriate introduction and use of modeling and decision support systems (DSS) can support and enhance strategic decision-making processes. Managing institutionalization of

such strategic decision support systems is the subject of this paper.

The critical challenges in the evolution and application of DSS lie in four main areas: strategic decision making, decision support systems, barriers to MS/OR/DSS

Organizations should not duplicate the same expensive failure experiences.

in practice, and institutionalization. The first set of challenges relates to the complex and messy nature of strategic decision-making processes. Among these challenges are

- The ill-structured nature of these processes which usually extend over long time periods (weeks, months...);
- The involvement of many participants and stake holders (strategic decision making is usually a group effort rather than an individual one);
- The need for conflict resolution, consensus building, cooperative problem solving, and crisis management; and
- The turbulent, dynamic environment in which decision making occurs with its constraints, opportunities, and variable assumptions.

Decision support systems represent a second set of challenges. DSS provide ways to integrate organizational decision making, the use of computers, and the use of models. They require a focus on

- Decisions, particularly those made by top management;
- Supporting the decision-making process rather than replacing managerial judgment;

- User involvement, response to user needs, and emphasis on individual decision making styles;
- Flexibility, adaptability, user dialogue, and quick response;
- Data from external as well as internal sources;
- Selection and use of the appropriate models, and the continuous examination of assumptions;
- The integration among models, data, and dialogue;
- The incremental, evolving prototyping approaches that link the changing needs of the user to the implementation process; and
- Linking prescription to a descriptive understanding of organizational decision making.

Decision support systems in this context are viewed as a vehicle and delivery process for relevant and successful implementation of MS/OR.

The third area of challenges relates to the problems of implementation of MS/OR in practice. Quite often the efforts of MS/OR professionals have been undermined by problems in implementation. Gass [1987] provided a detailed list of barriers to successful implementation. The following are some of the major factors in failures of implementation:

- Data: Untimely, unresponsive, or inadequate data;
- Models: Inadequacy of problem definition or model specification and design, nonresponsiveness to user needs and choices, and inadequacy of model evaluation;
- Users: Lack of user involvement and participation in MS/OR/DSS

- development, lack of top management support, resistance to change, lack of continuous communication, and enforcing quick response;
- Software and computer technology: Long and tedious efforts to develop software or DSS or other tools; poor documentation; and
- Interface: The inability of users to use a model because of inflexibility in model manipulation, unsuitable information and data representation, and cultural or linguistic problems (for example, translation problems between Arabic, French, Chinese, and so forth).

Schultz, Slevin, and Pinto [1987]; Keen, Bronsema, and Zuboff [1982]; Ginzberg [1981]; and El Sherif and El Sawy [1988] have examined the process of implementation with emphasis on information systems (IS) and DSS. Shultz views process implementation as involving a 10-factor model of project implementation, consisting of two phases, the strategy phase (the planning) and the tactical phase (the doing). Keen, Bronsema, and Zuboff stress the need to define a formal liaison role, the danger of overlooking the need for local development, the value of education, and the importance of defining and involving the users and obtaining the commitment of top management. Ginzberg emphasizes the importance of nontechnical dimensions in avoiding implementation failure. El Sherif [1982] stresses the importance of institutionalization in successful implementation, and El Sherif and El Sawy [1988] propose an issue-based approach to implementation of strategic-decision making DSS.

Guided by knowledge of these problems and processes, organizations should not duplicate the same expensive failure experiences. Lessons learned can be important prerequisites for guiding success.

Implementation, in our context, is a process by which a design is actually fulfilled by concrete measures, the outcome of which is a ready-to-use system.

The fourth area of challenges relates to the concept of institutionalization itself. Much of the difficulty with the term *institutionalization* can be traced to the differences between the theoretical, academic definition and the connotational, practical one. Webster defines institutionalize as "to incorporate into a structured and often highly formalized system." Social scientists define institutionalization as routinizing an ad-hoc process. Lawless [1987] defines it as "the process by which new practices become standard business in a local agency." He describes the institutionalization process as a series of changes to people, procedures, and organization structure.

The main challenges of institutionalization include the following:

- Overcoming resistance to change;
- Adapting model-based systems to the context of work and formulating related procedures;
- Managing the change from an old to a new process of work;
- Diffusing knowledge about the use of new models and systems; and
- Monitoring adoption of the new systems and their impact on individuals and the organization.

In our context, institutionalization of DSS is synonymous with continuous and

effective use of model-based DSS; thus, it requires continuous adaptation, diffusion, and adoption, and the assessment of the impact of strategic decision support systems. If such systems are appropriately implemented and institutionalized, they can serve as a base for continuous positive growth, as a catalyst for stimulating internal development, and as a nucleus for attracting potential innovation. This can contribute to learning and leveraging organizational, as well as individual knowledge, and making best use of accumulated experiences.

Managing the institutionalization of strategic DSS requires facing the combination of challenges provided by the intersection of the four areas discussed above. The strategic decision-making context, unlike the operational levels of an organization, is probably the most challenging context for institutionalization because it is messy, ill structured, and continuously changing. MS/OR models are more likely to fail in this context than in others if they are not flexible and adaptive.

Strategic Decision Making in the Cabinet

The Cabinet of Egypt is the highest executive body in the country; it consists of 32 ministers and is headed by the prime minister. Each minister is responsible for a given sector, for example; industry, agriculture, and energy. The cabinet addresses multisectoral issues, policies, and programs. The cabinet agenda is usually set according to the scope, urgency, and criticality of issues. In this regard, the cabinet interacts with ministries, parliament, governorates (states or provinces), government agencies, and universities. Its

decision-making process usually involves discussions, debates, the preparation of memoranda, and multi-sectoral studies. Late in 1984, Minister of Cabinet Affairs H.E. Dr. Atef Ebeid expressed interest in exploring the potential of DSS to assist the cabinet in strategic decision making. The minister identified areas of concern for the cabinet at that time. They included improving the effectiveness of the

The strategic decision-making context is probably the most challenging context for institutionalization.

cabinet's preparation of its agenda, its consideration of issues, and its decision making, improving the quality and reliability of information, improving the timeliness of decisions, and supporting the country's socio-economic reform programs. Dr. Ebeid asked me to develop a plan to address these challenges.

Following this identification process, the prime minister approved a preliminary project plan driven by policy needs and national development priorities to establish an information and decision support center (IDSC). IDSC was guided by three objectives: first, to develop information and decision support systems for the cabinet and top policy makers in Egypt; second, to support the establishment of decision support centers in existing ministries and to make more efficient and effective use of available information resources; third, and more indirect, to encourage, support, and initiate informatics projects to accelerate the managerial and

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technological development of Egyptian government ministries and agencies.

To achieve these objectives we developed a three level framework:

- At level one, we would build an IDSC base at the cabinet to provide cabinet issue support, information, and decision support, multi-sectoral analysis, and integration.
- At level two, national nodes would link IDSC with ministries and national agencies and support the building of local sources of information and decision support centers at ministries and national agencies.
- At level three, we would extend telecommunications access to international sources of information and major data bases.

Egypt, like many developing countries, was characterized at that time as data rich and information poor. Data were available, but they were of questionable reliability and relevance. Timely information was not available, and the integrity of information was often doubtful. After the proposed plan for IDSC was approved we started preliminary intensive efforts to put together a small qualified support staff for the new project. Implementation started in November 1985, based upon a specific set of priorities defined at that time.

IDSC Evolution

IDSC has evolved rapidly from three persons in November 1985 to more than 180 specialists in March 1989. This evolution consisted of three main phases of growth: initiation, base building, and take-off. Achieving the fourth phase, maturation, remains a challenging objective.

During the initiation phase, we faced a number of challenges: an underdeveloped information environment, heterogeneous data, growing policy and decision-making needs, a lack of credibility with decision makers, the need for detailed implementation plans, the need for resources to implement these plans, and finally, our own lack of experience in providing information and effective support for strategic decision making. In facing these challenges, one of our guiding principles was, and still is, not to duplicate any previous efforts done anywhere whether inside or outside the country. Initially, we thought that the answers to our problems already existed somewhere else and could be obtained quickly. We learned later on that only some of the answers were there; we had to develop the rest.

In the base building phase, we put together the preliminary infrastructure of IDSC, including specialists, computers, temporary office space, a handful of previous relevant studies, and scattered non-integrable data bases. We started implementing projects and the incremental results started to build some credibility — we were able to respond to ministerial, sectorial, and governorate needs for DSS. These governmental bodies gave us strong support because of a consensus that they needed an accelerated approach in order to build their data bases, DSS capabilities, and local staff specialists that could interface with IDSC.

We discussed IDSC organizational design and decided to subcontract most of the administrative and financial functions to one of the cabinet organizations. Our governing belief was that we should not

build a bureaucracy that could lead to an empire.

Fourteen months after IDSC began we started the take-off phase. By early 1987, 24 projects were in progress, which provided enormous challenges to the new staff. We adopted a preliminary organizational structure to cope with the increasing demands and to support the pace of implementation at IDSC. Based upon our existing knowledge about DSS applications and learning from the processes of implementation taking place, we developed an issue-based DSS approach and

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later on used it to guide the design and delivery of all our DSS projects [El Sherif and El Sawy 1988]. Parallel to this, we devoted intensive effort to building data bases and mobilizing our modeling capabilities, linking them together to support strategic decision making. Our efforts succeeded in incrementally positioning and institutionalizing IDSC within the cabinet as an integrator, facilitator, and expeditor of information and decision support capabilities for cabinet decision making and, in turn, linking cabinet decision making to ministerial, sectoral, and governorate decision making.

Problem Definition

Our efforts to July 1989 and their outcome show that, while implementation of DSS appeared difficult, institutionalization of strategic decision support systems

is far more challenging. Despite the successful implementation of more than 35 projects, we clearly faced problems in institutionalization.

Minister Ebeid questioned our future: What will happen after one year? two years? ten years? Are these decision support systems going to be used and developed, or aborted? Is this going to be another failure story, or can the present organization be a nucleus for growth and success? What do we need to guarantee that what we deliver today is going to contribute to the future?

These questions pointed out the problems and concerns we faced in managing institutionalization of strategic decision support systems. Our experience in introducing, developing, and fostering the use of decision support systems made it clear that managing institutionalization is as important as model building. It should be an explicit, complementary, and integrated process that accompanies systems development and model building.

An Approach for Managing Institutionalization of Strategic DSS

IDSC has developed an approach for managing institutionalization of strategic DSS. This approach consists of two main phases: an implementation phase and an institutionalization phase (Figure 1).

Phase 1, the implementation phase is viewed as the processes of design and delivery of the strategic DSS. It consists of the following tasks:

- (1) Structuring the strategic issue,
- (2) Defining information requirements around the strategic issue,
- (3) Defining information support services around the strategic issue,

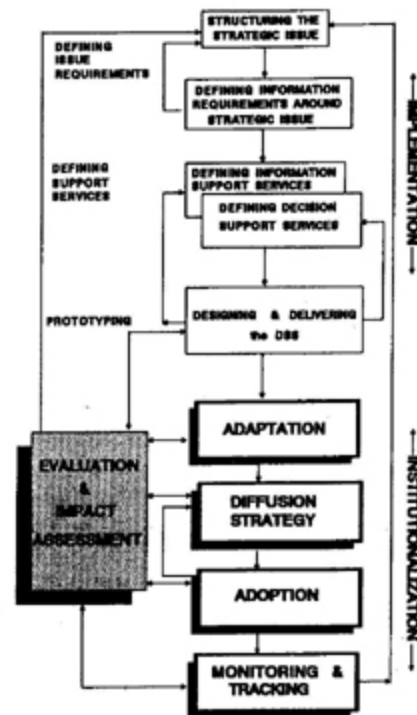


Figure 1: Our two — phase approach to managing institutionalization of strategic decision making evolved after we realized that institutionalization is as important as model building.

- (4) Defining decision support services around the strategic issue, and
- (5) Prototyping the design and delivery of DSS related to the strategic issue.

Phase 2, the institutionalization of the strategic DSS consists of five main components:

- (1) Adapting the DSS to meet context needs, "the cultural interface,"
- (2) Diffusing knowledge about the DSS, "the organizational interface,"
- (3) Encouraging adoption of the DSS, "the user interface,"

- (4) Evaluating and assessing the impact of the DSS, and
- (5) Monitoring and tracking its usefulness.

We at IDSC see the institutionalization approach as a natural extension of the issue-based approach defined in El Sherif and El Sawy [1988]. Table 1 shows the tactical elements of the approach in terms of outcomes, typical activities, the methods and tools, and key participants.

Adaptation

Adaptation of the DSS includes its modification to fit the contextual and cultural characteristics of the environment. A cultural interface is designed and implemented. In IDSC projects, this included designing Arabic interfaces for all previously developed systems, training the users, managing the users' learning processes, and teaching them about the modeling capabilities of the system.

Diffusion

The diffusion strategy emphasizes spreading the use of DSS at various organizational levels. DSS should have attributes that facilitate and speed up diffusion, for example, an advantage over the current method, compatibility with other systems in use, ease of trial, and observable use. Managing the demonstration of these elements is part of the strategy. The spread of use is measured by how many people use DSS effectively. The diffusion phase also includes organizational redesign, systemization of tasks previously performed manually, and development of new job descriptions, rules, and procedures.

Adoption

Adoption refers to the personalized use of the new tools by managers, decision

Outcomes	Typical Activity	Representative Methods & Tools	Typical Key Participants
Adaptation			
DSS Incremental Uses	Culture Adaptation Training User Support	Software Interface for Arabic Training Workshop Meetings	DSS Consultants Trainers MS/OR/DSS Staff User/Staff Intermediaries
Diffusion			
DSS Diffusion by Organizations Units	Internal Diffusion Strategy Organization Redesign Routine Design Inauguration, Managing Public Image	Group Meetings Training Organization Structure, Job Descriptions, Rules/Procedures Media, Public Relations	Key Decision Makers Trainers Staff Intermediaries DSS Consultants Stakeholders, Policy Makers, DSS Staff
Adoption			
Individual Development and Use	Personalization, Customization User Adaptation Incentive System Definition Entrepreneurship, Self-Starter Development	User Interface Software Design Incentive Promotion Scheme Workshops	MS/OR/DSS Coaches Internal Staff/Users
Evaluation and Impact Assessment			
Measuring Degree of Institutionalization and Value Added	Utilization Assessment Operational Problems Identification SDM'ing Value Assessment Risk & Cost Analysis Technical Evaluation Maintenance Documentation Impact Assessment Termination of Use	Standards Institutionalization Indicators Periodic Reporting Value Analysis Validation Methods (data, assumptions, models, operations)	MS/OR/DSS Consultants Users Decision Makers
Monitoring and Tracking			
Dynamic Tracking System	Information & Data Tracking Assumption Surfacing Issue Tracking Priority Management Crisis Monitoring Alternative Search Innovation Tracking	Information & Data Access Utilities Shuttle Diplomacy Resource Allocation Exception Reporting	MS/OR/DSS Consultants Internal Staff

Table 1: The tactical elements of our approach for managing institutionalization help in defining the activities, the methods and tools, and the participants interacting at each phase.

makers, and support staff. The system may have to be customized and adjusted to the individual, his or her mental

context, managerial style, and jargon. Besides, the system should help stimulate internal innovation and DSS development.

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Evaluation

Evaluation is a fundamental component interacting with all the other phases of institutionalization. It should incorporate methods for assessing utilization and identifying operational problems. In addition, it should include measuring the value added to strategic decision making, assessing the impact of the DSS, analyzing risks and costs, technical evaluation, maintenance, and documentation. To evaluate a system's performance, the practitioner must establish standards and indicators of the level of institutionalization and perform value analysis and validate the system. Robey [1987] argues that implementation must also include managing long-term organizational changes and the strong coupling between implementation of a system and its impact. A system's impact should be planned rather than accidental. DSS should be terminated when the DSS model technology becomes obsolete or when a better alternative system is available.

Monitoring and Tracking

The dynamic tracking component is used to monitor shifts in the parameters of critical issues, assumptions, priorities, data and information, and changes in technology and in its impact. This allows for dynamic search of strategic alternatives.

Illustrative Cases

By November 1988, IDSC had implemented more than 35 large projects that involve the cabinet, the ministries, governorates, and sectors. I will describe three DSS cases: establishing new customs tariffs, debt management, and planning energy and irrigation.

CASE 1: A DSS for Formulating Customs Tariff Policy

In an attempt to implement one of Egypt's reform programs, the cabinet put a new customs tariff on its agenda in early 1986. In April, the main features of the intended legislation were leaked to the press. In response, business stagnated until the new tariff was formally announced four months later. During this four-month period, multi-sectoral conflicts grew among six ministries. We developed DSS with three main objectives: to achieve a homogenous and consistent tariff structure; to increase the revenue of the government; and, to minimize the burden on low-income groups.

A group headed by an undersecretary from the Ministry of Finance and an IDSC DSS consultant formed a joint team which interacted intensively with ministers from key sectors to build a model. The team used the feedback from its negotiations with the ministers to modify the models, parameters, and assumptions and to generate scenarios. After one month, conflict was resolved, and later on all the cabinet members unanimously endorsed the new model-based proposal. The new legislation had the full acceptance of the business sector and of the government.

The development team, which had been supported by the government, realized immediately how important it was to institutionalize the model building process. It proposed that a permanent body be formed, and the government approved legislation to form a permanent team to monitor the DSS and any needed changes.

A year later, due to adjustments in the currency exchange rate, a new amended custom tariff structure had to be formulated. The model assumptions had to be reexamined, the data had to be updated, and the process was almost repeated. Because the system had not been institutionalized, a year was lost and we had to almost repeat the work.

Consequently, IDSC formulated a plan for a process of institutionalization. Such a plan had been used by the Ministry of Finance staff. It provided for in-house intensive training on microcomputer-based systems. The undersecretary put an internal diffusion strategy into action, allowing about 30 staff members to obtain full knowledge of the system.

Having a system to formulate and monitor tariff changes has increased customs revenue during the last two-and-a-half years. The actual amount of the increase is US\$ 56 million for the first year, US\$ 167 million for the second year, and US\$ 127 million for the last six months, a total of US\$ 350 million. Changes are now tracked as an integral part of the internal work and procedures; this has been facilitated by the use of information technology. The systems are fully integrated into the department's operations.

CASE 2: Debt Management

Debt has been a growing acute problem that impedes the economic development of the country and the implementation of its five-year plan. Egypt has accumulated a foreign debt of US\$ 33 billion; this money was needed to rebuild its economy during the '70s and '80s. Prior to the debt management project, transactions used to be handled on a loan-by-loan basis, over

the years amounting to more than 5,000 loans. It was extremely difficult to monitor and manage the country's debt and its services on a global basis, including sources of funds, renegotiation of terms and interest rates, and payment schedules.

In 1985, Egypt was facing great economic pressures. Its main resources — oil, the Suez Canal, foreign remittances, and tourism — were shrinking, and its creditors were refusing to provide more

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loans. The debt problem was particularly pressing. A World Bank expert estimated that the cost of servicing the debt amounted to US\$ 1 million every six hours.

In September 1986, we launched a project to develop a debt-management system. We originally perceived it as a database system and exerted massive efforts to collect scattered data, faced with disorganized manuals and undocumented systems. Egypt hoped to achieve partial rescheduling with Paris Club members.

We had to develop a forecasting and sensitivity analysis model that would provide full support during the process of rescheduling the debt payments with major creditors. The negotiations were successful and Egypt's foreign debt was rescheduled, which top policy makers considered a success. Following this perceived success, the cabinet requested a simulation of the future debt burden, including possible scenarios and strategies.

The success of the implementation was viewed as a national achievement by both the cabinet and the public. H.E. Prime Minister Dr. Atef Sedky and seven ministers were present at the inauguration ceremony on completion of the technical phase at the Central Bank of Egypt. The IDSC project manager described the capabilities of the system and introduced the central bank internal team members, who had participated heavily in the implementation. The inauguration was given a lot of media attention. Visibility and recognition have promoted commitment to the process of institutionalization and helped greatly in building awareness of this project and of DSS activities in general. Following this presentation, we received increasing requests from a number of ministries interested in using the system.

Although such use had been foreseen, we had made no plans to integrate such potential users. Furthermore, we received requests to link the central base to the major banks in Egypt. Adapting the system to such a large number of users and extending it to new basic sources of data were challenging. Five ministers wanted access to the information and modeling capabilities. We held meetings to formulate their needs precisely and to put together a diffusion strategy.

The changes in debt status, loans, conditions, and the agreements reached with various creditors overloaded the tracking function of the project. It included not only information and data tracking but also issue tracking, prioritization, re-examination of assumptions, generation of alternatives, and crisis management.

The management of the central bank

gradually realized that top management support was necessary to get the first phase of the project implemented. However, to get it institutionalized, it had to follow an organization-wide multi-tier strategy. We revised the project plan to reflect these new perceptions. We launched a training and education plan parallel to the institutionalization process that was aimed at top management and middle and third line operational staff. This resulted in a growing commitment and involvement on the part of members of the organization. In parallel, we integrated a periodic, monthly, impact-assessment process with the DSS delivery and use process. This resulted in a well-guided project institutionalization process.

CASE 3: A DSS for The Ministry of Electricity and the Ministry of Irrigation

In August 1987, the Minister of Electricity and Energy requested decision support services for strategic issues in his sector. As he put it then, "the cost of providing electricity contributes increasingly to the deficit in the national budget and balance of payments. Most investments in electrical power generation require foreign currency. Besides, the current tariff structure still requires government subsidies."

In response to his request, we developed a pricing model embedded in a DSS that allowed users to generate scenarios and alternatives. The model, which evolved over several versions, allowed the ministry to generate new tariff policy scenarios and to build an expert group for internal support which acted as a catalyst. Due to the new tariff policy, revenue increased by 160 million Egyptian

pounds during its first year of implementation. The tariff policy and structure are monitored periodically.

The minister thought the model had helped to reduce budget deficits as it adjusted the price structure. Satisfied with the outcome, the minister assigned his first undersecretary the task of putting together joint teams with IDSC to establish an information and decision support center for the ministry. He formed seven teams, each headed by a competent leader. Each team was to build one system and manage its delivery, implementation, and use. The systems modeled pricing, debt management, energy production and consumption, project monitoring, capital goods, legislation, and studies. Following implementation, the systems were put to use. All computer-based models were developed with an Arabic language interface to accommodate the ministry staff. The project manager quickly realized that implementing the easy-to-use DSS was not sufficient. He initiated and developed a process of institutionalization which included training the DSS staff users and top management, redesigning the existing organizational structure, developing an internal procedure including an incentive system, and customizing the DSS.

Subsequent to the implementation of the DSS the level of the Nile declined sharply and threatened to decrease the level of power generation from the Aswan Dam. The cabinet debated the situation intensely, as did the public and the news media. A potential crisis in both energy and irrigation surfaced. The cabinet sought feasible solutions. It requested a

US\$ 500 million loan for building power stations, which was approved. Nile water is essential for agricultural production.

The crisis stimulated the ministry to generate additional models. The water deficit that surfaced in 1988 actually goes back to 1981. Since that time, Egypt has been facing a period of water deficit. Between 1981 and 1988, the upstream water level of the High Aswan Dam fell from a maximum of 177 meters above sea level to about 151 meters. This was very close to the 147 meter level at which no hydropower can be generated.

Responding to this issue, the water planning group of the ministry of irrigation joined IDSC to start to use the modeling capabilities already developed by the

The cost of servicing the debt amounted to US\$ 1 million every six hours.

water planning group. We thoroughly examined the models and assumptions, updated data and validated the model. We used two main models: (1) the Lake Nasser simulation model, and (2) the High Aswan Dam optimal operation model. The lake simulation is a water balance model of the lake that uses the following data: incoming Nile flow; characteristics of the lake and dam in terms of hydroelectric power generation, water level, evaporation, seepage and volume/surface area/level relations; and alternative operating policies in terms of scheduled releases. The simulation model predicted the resulting monthly water levels, losses, and energy production.

The High Aswan Dam optimal operation model is a stochastic dynamic programming model that uses the inflow series transition probabilities and data about physical reservoir constraints, as well as decision-maker preferences concerning irrigation demand, hydropower generation, and downstream degradation. In turn, the model provides optimal monthly operating rules for the reservoir. We used the results of applying the two models in presenting several policy alternatives to the cabinet to illustrate the effects of different release policies downstream of the High Aswan Dam, and their future impact on the hydraulic performance of the reservoir. The cabinet decided to decrease the water released

H. E. Prime Minister Dr. Atef Sedky and seven ministers were present at the inauguration ceremony.

downstream from the reservoir by about five percent for the hydraulic year 1987-1988; this amounted to three milliards cubic meters.

The valuable support provided by the models during the water crisis made top decision makers in the irrigation sector more aware of the capabilities of decision support tools for planning. The minister of irrigation welcomed having DSS in his office to provide assistance in solving water resources issues and in better managing future crises. IDSC has developed a DSS that consists of different planning models for crucial water resource problems.

Lessons Learned

The incremental implementation of DSS has been a learning experience for the IDSC staff and for different ministries. This learning enhanced and leveraged the institutionalization processes. These are some of the lessons we learned:

- Implementation success is a necessary but not sufficient condition for institutionalization.
- Institutionalization should be integrated within the planning and design stages.
- Development and implementation of strategic DSS require a diffusion strategy that includes key actors, stakeholders, and users. The access of intra- and interorganizational users should be planned and managed.
- Dynamic tracking is an integrable, critical, and very time-consuming part of the institutionalization of strategic decision making.
- Linguistic and cultural adaptation of user interfaces is a key to bridging the application gap.
- While successful implementation is based upon top management support, successful institutionalization is based upon organizational support.
- Institutionalization of sectoral DSS can provide opportunities for developing multi-sectoral decision support.
- The impact of DSS needs to be planned and managed, and requires continuous attention on the part of the model builder.
- Evaluating strategic decision support and its impact is a basic process that should accompany all phases of implementation and institutionalization.

- The institutionalization process should be coupled with the implementation process.
- Training and education is a dynamic component that accelerates the adaptation, diffusion, and adoption of DSS.

Rethinking Implementation and Institutionalization

The projects developed to date, have provided a forum for rethinking and learning about implementation and institutionalization of strategic decision support systems. Our approach has evolved incrementally. Successful institutionalization is a stepwise refining process. We had some noticeable failures during our learning process that could be traced back to one of the following factors: the absence of an institutionalization plan integrated with the implementation plan, lack of top management support, a failure to design adaptation interfaces or to consider the user's requirements, the absence of an evaluation and impact assessment mechanism that was integrated with all phases of the project, or a failure to realize the importance of tracking.

Some projects, like those concerning debt and customs, have been difficult to institutionalize because one of the essential components of the institutionalization change strategy was missing. In both of these cases, for example, coping with factors not foreseen at the beginning of the project implied an additional burden and required an adaptive institutionalization process. In addition, they needed tracking.

Making sure that all the essential factors were present in other projects proved to be an important fundamental component, not only for the projects' institution-

alization but for coupling the outcome of the models and DSS to strategic decision making and guaranteeing its effectiveness. It allowed feedback and restructuring of strategic issues and insured that the DSS staff was linked to policy makers and their changing needs.

The electricity and irrigation project provided us with important lessons for measuring the extent of institutionalization. Four generic yardsticks have evolved to date:

- A measure of the cultural interface: The ability of users to use the system in few hours is an indication of successful cultural interface.
- A measure of the organization interface: The responsiveness of the organization to change or to unexpected situations indicates a coupling between the existing organization and innovation.
- A measure of the user interface: The extent to which users provide continuous, dynamic, and effective support for strategic decision making is a measure of the effectiveness of the user interface.
- A measure of growth: The extent of effective internal developments and innovations indicates growth.

Over time, the criteria of success have shifted. At first, we emphasized successful implementation, then the use of the systems, and now we stress successful institutionalization and growth.

Our experience with various projects has taught us a great deal about Egyptian managers. They tend to be more comfortable using an Arabic spread sheet. Managers are biased towards using different

scenarios rather than probabilistic modeling (they think in terms of permutations rather than probabilities). In adopting DSS, they tend to accept heuristics more readily than algorithmic models. This seems consistent with what Little [1986, p.4] reported as an outcome of his research in the decision and management sciences, that "real world decision makers in managerial roles use much judgment under conditions of uncertainty and risk. There is a need for what might be called guessing systems and therefore deeper fundamental theories of how people do and should employ judgment in actual managerial situations."

On the other hand, the Egyptian context has allowed us to identify gaps constraining the use of MS/OR/DSS in practice and to formulate strategies to manage those gaps. We have identified two gaps: the application gap and the institutionalization gap. The application gap is the distance between the technical state of the art (T-S-O-A) and the application state of the art (A-S-O-A). T-S-O-A refers to scholarly advances, academia, or innovations, while A-S-O-A refers to the most advanced application implemented as a result of T-O-S-A. The institutionalization gap is the distance between the A-S-O-A and the user state of the art (U-S-O-A). U-S-O-A refers to applications that are now in common use (diffused and institutionalized) within a certain country. To manage such gaps we had to devise contextual fit strategies that were unique to IDSC.

Our experiences to date have confirmed the importance of the policy maker, the internal gate keeper (the champion), and

the "chauffeur" of the DSS (the staff intermediary) in the process of institutionalization. The presence of these three actors is necessary for successful institutionalization. Face-to-face communication and interaction with decision makers enhances, builds commitment, and provides motivation towards the process. Ministers and top executives, however, revealed that while they are willing and interested in learning about the use of DSS in the beginning, later on they do not personally use the computer. They rely on their DSS staff assistants to act as intermediaries.

Furthermore, the institution of "think tanks" near areas of strategic decision making has created new unforeseen demands. It has encouraged coupling between individuals and DSS information technology, as well as coupling between the organization and DSS information technology. This close coordination permits quick response in unexpected situations, and quick adaptation of organization processes to contextual changes.

Institutionalization is a multi-dimensional endeavor. Linstone [1985, p.77], argues that a multiple perspective approach is needed to overcome the weaknesses of MS/OR, particularly in ill-structured contexts. He advocates "that the multiple perspective concept originally suggested by Allison, effectively bridges the gap between analysis and the real world of ill-structured systems. Three types of perspectives were proposed: technical/analytical; organizational/societal, and personal/individual." The multi-dimensional approach to institutionalization in Egypt was very successful.

Process	Cabinet	Corporation
Strategic Decision Making		
Executive body	Cabinet	Board
Top management level	Prime Minister & Ministers	CEO & VIP's
Responsibilities	— Mission statement — Policy directive — Economic reform program	— Mission statement — Corporate strategy — Strategic plans — Support Institutionalization
Strategic Decision Support		
Management level	Undersecretary & IDSC	VP & DSS/MS/OR Department
Responsibilities	— DSS/MS/OR defining projects — Eliciting strategic issues	— DSS/MS/OR defining projects — Eliciting strategic issues
DSS Design and Delivery		
Organizational level	IDSC DSS Builder	Corporate MS/OR or DSS
Responsibilities	— Implementation	System Builder — Implementation
Institutionalization		
Organizational level	Individual manager/user	Individual manager/user
Responsibilities	— Use, adoption, and growth	— Use, adoption, and growth

Table 2: A comparison of the responsibilities for institutionalization between the organizational structures of the cabinet and a corporation clearly indicates the transportability of the process.

Finally, we can draw parallels between strategic decision making in Egypt and that in corporate settings. Table 2 compares the different actors in the two settings and their responsibilities. This comparison stresses the responsibilities of all actors at all levels in supporting institutionalization. The transportability of the approach to different application areas in Egypt demonstrated its potential for other countries. Kraemer and King [1986] examined the use of computer-based models for policy making in the US and its impact; they emphasized the same notion of institutionalization presented here.

Value Assessment

The use of decision support systems has greatly improved strategic decision making in Egypt. The values and benefits from the implementation and institutionalization of DSS projects can be demonstrated in terms of tangible and intangible effects.

In the customs project, the use of DSS intervened and resolved the conflict among six ministries, allowing a new tariff policy law to be issued after more than six months of debate. In addition, it provided a balance between social and economic gains. On the other hand, it placed no extra burden on low income groups, and on the other hand, it provided annual increases in customs revenue that totaled US\$ 350 million over two and a half years.

The debt management DSS provided support for rescheduling Egypt's debt with Paris Club members, IMF, and other creditors; in addition, it provided assistance in reducing the debt burden through better, dynamic portfolio management. It is difficult to ignore the potential of effective information provided by DSSs when DSSs have been useful in negotiating a one percent difference in interest on a debt of US\$ 33 billion. The amount saved

amounts to US\$ 330 million. The project has become a reference for success, demonstrating the effectiveness of an institutionalized computer-based model.

The electricity DSS has been effective in providing a new electricity bill, price monitoring, and restructuring, all of which helped increase revenue by about 160 million Egyptian pounds in its first year. Since then, the return has been growing annually.

Other benefits include the following:

- Improving strategic decision making at the cabinet, ministries, and governorates has created a better understanding of the nature and complexity of strategic decision alternatives and provided insights into new opportunities.
- Strategic DSSs can help officials to better manage crises and to respond quickly to unexpected situations.
- Using such DSSs can improve communication between cabinet members, ministries, and governors. This encourages better teamwork at different levels and sectors, making best use of available resources.
- Successful DSS projects increase the awareness of the cabinet and the public of the importance of MS/OR/DSS and provide them with realistic operational examples of DSSs in practice.
- One tangible outcome of the implementation of various DSS projects has been the decision support centers established at the cabinet, and at five ministries, four governorates, two sectors, and six agencies. Several other projects to develop national strategic management DSSs are in progress.

The total accumulated expenditure for

projects, including the building of DSS centers, during the period between November 1985 and February 1989 is 12.71 million Egyptian pounds (US\$ 5.4 million). In general, the benefits and value of the DSS projects in Egypt confirmed their worth beyond the orthodox cost/benefit analysis. Although quantifiable benefits

Our experience has taught us a great deal about Egyptian managers.

were clearly demonstrated, intangible benefits proved to be equally important. Adopting an approach towards managing the institutionalization of strategic decision support systems provided tangible and intangible benefits that greatly exceeded the benefits initially expected.

Conclusions

Using DSS for the Cabinet of Egypt has significantly improved the strategic decision-making process. In less than three years, the cabinet, ministers, and governors have increased their use of models. Decision support systems have contributed significantly to the effectiveness of strategy formulation, of economic and social reform programs, of policy decisions, of setting cabinet agendas, of crisis management, and of the governorates' ability to track continuous changes.

Our approach to managing the process of institutionalization of DSS and model building allowed us to focus on making use of islands of models, professionals, and computer resources that were underutilized and to respond to the existing latent demand of decision makers. This

approach worked in more than 30 settings that had a variety of managerial and technological infrastructures. In a recent official cabinet address, H.E. Minister Ebeid said,

We hope that the impact of DSS will continue to be felt in strategic decision making at both the cabinet and ministerial levels. We will continue to work towards transforming the ways by which strategic decisions are made, resources are better managed, and environmental shifts are effectively responded to. We believe that we have the responsibility not only to formulate reform programs or to suggest modern management or DSS systems but as well to make sure that today's prescriptions, models, and solutions will be integrated and institutionalized within organizations in Egypt. We are trying hard to manage such processes of integration and institutionalization.

We believe that this commitment resulted from our actual implementation and institutionalization of DSS. The benefits we gained were due to the appropriate use of MS/OR/DSS in practice to overcome the many challenges facing strategic decision making.

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