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Executive Overview

This SIM award-winning paper is a fascinating and informative article on the use of DSS technology in an unconventional setting. From November 1985 to March 1988, the Cabinet Information and Decision Support Center has grown from a startup organization to one of over 150 people. Using five example projects, this article identifies the 10 generic lessons learned from them. The 10 lessons are listed at the end of this overview. Very well written, this article has real value for the CIO and others interested in DSS implementation. Its strength lies in its capturing of *real-world* implementation issues.

- **Lesson #1:** Structuring and articulating strategic issues is an integral, critical, and time-consuming portion of the design/delivery of DSS for strategic decisions. It should be labelled as an explicit "rewardable/billable" activity in the design/delivery cycle. It includes conflict resolution and consensus building, and may involve shuttle diplomacy.
- **Lesson #2:** Providing DSS for strategic decision making is most often coupled with both urgency and criticality, making crisis management a frequent mode of operation. This requires an organization design and human resource policy for the support organization that explicitly includes a crisis management component. This type of crisis management has large, unexpected variance in tempo and task (i.e., more like a fire department than an overnight package-delivery business). IDSC has added crisis management teams to its organization design. (See Figure 4.) These can be quickly put together in response to crisis requests.
- **Lesson #3:** Providing information and decision support for strategic decision making often requires much effort in building and integrating databases from diverse, extra-organizational sources. The front-line decision-support consultants should not get sucked into this activity at the expense of reduced decision support. The organizational design should reflect this.
- **Lesson #4:** The structuring of one strategic issue begets other strategic issues, which can be used to focus the database building effort.
- **Lesson #5:** It is vital to explicitly articulate to users that effective decision making depends on more than information. For decisions surrounding strategic issues, information is usually partial, and its quality is questionable. Rather than just trying to improve information quality, it may often be more useful to use more decision methods/heuristics.
- **Lesson #6:** If recurring decisions are to be made around a strategic issue, there is a critical need for setting up a management system for tracking and monitoring changes in the critical parameters of the issue.
- **Lesson #7:** The dynamic tracking component of an issue-based DSS has the usual technical demands of transaction processing systems and requires more demanding technological capabilities.
- **Lesson #8:** The issue-based approach to DSS provides a solid base for easy transition to EIS in the future.
- **Lesson #9:** It was not only DSS design that could be prototyped; the management of delivery could be prototyped as well.
- **Lesson #10:** Providing decision support for strategic decision making will require much textual and document-based information sources. Organizational design should reflect this capability.

Issue-Based Decision Support Systems for the Egyptian Cabinet

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Abstract

This paper provides a new approach for managing the design and delivery of information and decision support systems for strategic decision making. It draws on experiences gained from implementing systems and services for enhancing the strategic decision-making process of the Cabinet of Egypt. The article challenges the conventional views of conceptualizing decision support systems and methods for managing them. It introduces an "issue-based" management method for the design and delivery processes. The distinctive features of this approach include a focus on issues rather than decisions, a distinction between information support services and decision support services, prototyping the management of delivery as well as design, and a dynamic tracking back-end. Finally, the article compares the conventional and issue-based DSS approaches. Such a comparison suggests that the issue-based approach can be an effective stepping stone for the design and delivery of executive information systems (EIS) in corporate contexts by providing DSS that are "EIS-ready."

Keywords: decision support systems, executive information systems, information requirements determination, strategic decision making, issues management, governmental agencies, management of large-scale information systems, information systems implementation

ACM Categories: H.4, J.1, K.6

Information and Decision Support for Strategic Decision Making

The effectiveness of strategic decisions can have enormous impacts on organizations and their successful functioning. Consequently, it is a critical priority for information systems professionals to effectively provide organizations with information and decision support systems that support and enhance the strategic decision-making process. The process of managing the design and delivery of such systems is reported and examined in this article.

Information systems professionals generally agree that — despite the advances in the design and implementation of decision support systems (DSS) in the last decade, and despite the rapid strides in information technology capabilities and the relatively widespread acceptance of DSS by professionals and middle managers, and even despite the recent emergence of executive information systems (EIS) — the provision of effective DSS for strategic decision making remains a challenge that we have yet to overcome.

While there are examples of successful DSS used for strategic decision making by top managers in such decision contexts as mergers and acquisitions, plant location, and capital expenditures, these systems tend to focus on limited, well-structured phases of specific decisions. However, when it comes to supporting the whole strategic decision-making process over time with competing and changing strategic issues, multiple decisions, and changing participants, much less progress has been made. The motivation for this article is to contribute one more step toward overcoming that challenge.

A large part of the challenge comes from the messy, complex nature of the strategic decision-

making process itself and the accompanying encumbrances that it brings to the DSS design and delivery situation:

- Strategic decision making is a murky, ill-structured process that can be drawn out over weeks and months yet often requires very rapid response capabilities in crisis situations.
- Strategic decision making is usually a group effort rather than an individual one, and it involves activities such as cooperative ideation, cooperative problem solving, conflict resolution, negotiation, crisis management, and consensus building (cf. Gray, 1988).
- Strategic decision making in turbulent and dynamic environments is accompanied by a large environmental-scanning component, which has its own information requirements for early warning about potential discontinuities, surprises, threats, and opportunities (cf. El Sawy, 1985).
- A strategic decision involves multiple stakeholders with different implicit assumptions that need to be surfaced and made explicit (cf. Mason and Mitroff, 1981).
- Strategy formation in dynamic environments takes place in a somewhat less deliberate and a much more emergent fashion than conventional descriptions of strategic management suggest, bringing with it a large serendipitous discovery component whose support requirements are difficult to forecast (cf. Mintzberg and Waters, 1985).
- Since a large proportion of information needed for strategic decision making comes from a virtually unlimited external environment, the key problem that the decision maker faces is information overload with multiple and conflicting interpretations rather than solely the absence of relevant information (cf. Zmud, 1986).
- Much of the information that is used for strategic decisions is qualitative, verbal, and poorly recorded.
- Because the stakes in strategic decision making are very high, there is much more situational vulnerability to both political maneuvering and stressed emotional behavior, which may call for additional considerations in DSS implementation.

Another part of the challenge comes from the nature of the decision maker, who typically engages in the strategic decision-making process as one of the central participants. He or she is usually:

- A top manager, executive, or policy maker whose time is very valuable.
- Older and more resistant to technological change.
- Comfortable relying on intuition and gut feeling.
- Unwilling to spend time learning to use computer-based DSS.
- Powerful enough to require and enforce quick response to his or her demands.

The call for designing and delivering DSS for such a demanding class of decision-making situations and decision makers has not gone unheeded in the information systems community. Various efforts have been made to advance the state-of-the-art, each of which has moved us closer toward overcoming that challenge. These include:

- Focusing on the decision maker and providing generalized support tailored to senior executives in the form of EIS (cf. Houdeshel and Watson, 1987, for a description of MIDS system at Lockheed Georgia; cf. Rockart and DeLong, 1988).
- Focusing on the provision of EIS generators with user-seductive technology platforms suited to executives, with fancy graphics, pop-up menus, touchscreens, and optical mice (cf. Paller, 1988; typical examples include products from software vendors such as Comshare, Execucom, and Pilot).
- Focusing on better understanding of the decision context (cf. Stabell, 1983, who advocates "bringing the D back into DSS").
- Focusing on information requirements determination methodologies that foster the fit between the executive decision maker and the strategic decision context (cf. Henderson, et al., 1987).
- Focusing on the structuring of fit between the decision context and the decision makers by building decision rooms and group decision support systems (cf. Gray, 1987).
- Focusing on the simultaneous advancement of the "squeakiest wheels" in DSS design and implementation (cf. Keen, 1987, in his call to action for "a redressing of the balance between D, S, and S").

The approach taken here builds on the experiences gained from the above. However, this approach tries to make progress toward overcoming the aforementioned challenges through focusing on the process of *managing* the design and delivery of DSS while preserving the fit among the decision makers, the form of support provided, and the technologies used in the context of an on-going strategic decision-making context. The application context is the Cabinet of Egypt.

Decision Making in the Egyptian Cabinet

The Egyptian Cabinet comprises the prime minister, thirty-two ministers, and four sectoral ministerial committees assisted by staff. Decision making at the Cabinet level addresses a variety of national socio-economic and infrastructural concerns, such as reducing the deficit in the balance of payments and national budget, debt management, performance improvement of public sector organizations, ways of promoting the development of small- and medium-scale private industries, and the allocation of resources to solve urban housing problems and overpopulation.

Depending on the scope, urgency, and criticality of an issue, it is addressed either through the ministerial committees or by the full Cabinet. The decision-making process involves much debate and group discussion, requires much preparation of position papers and studies, and is subject to public accountability and media attention. A simplified view of the Cabinet decision-making process, showing key participants, deliberation forums, and information flows is depicted in Figure 1.

As is the case with any decision-making setting, the Cabinet has its own jargon and mental constructions. Labels indicative of deliberate, structured logic (such as objectives, outcomes, directives, and decrees) and rational decision making (such as decisions, alternatives, choices, problems, and solutions) are used in both written and oral communication. However, a closer examination reveals that a decision-making process is most comfortably viewed by the participants as a process of attention to sets of *issues* with varying and shifting priorities; the Cabinet world is chunked primarily into issues rather than decisions. As indicated in Figure 1 by the closed loops, sets of issues circulate continuously and are managed over time. They enter and exit circulation through the key participants. When some issues are resolved (or dissolved) by decisions, actions, political maneuvering, or environmental shifts, they fade from circulation.

Similarly, issues can reappear and also become more salient. The Cabinet does, of course, make decisions, but the focal point of deliberation is the issue rather than the one of many decisions made around it.

The issues considered by the Cabinet are usually complex, ill-structured, interdependent, and multi-sectoral, with strategic impacts at the national, regional, and international level. The nature of the information environment can be characterized as one that is data rich but information poor. There is an overload of information of questionable reliability, which often yields multiple and murky interpretations, and which is often qualitative and disjointed. The Cabinet is the epitome of strategic decision making at the group level under complex and turbulent conditions, a situation that cries out for information and decision support systems (IS/DSS).

After Egypt's peace agreement with Israel, the Cabinet of Egypt embarked on a program of economic revival and was faced with formidable infrastructural and socio-economic development challenges in the early 1980s. In addition, politics and the turbulence of the regional and international economy were causing major shifts in Egypt's traditional sources of GNP, such as Suez Canal revenues, remittances from Egyptians working in oil-rich countries, and tourism. This created a heightened awareness of the increasing complexity of the environment and of the vulnerability of static plans and slow decision making at the strategic level. It also brought into focus the critical importance of making available in an integrated form the information needed for supporting the decision-making process of the Cabinet through the use of the most appropriate information technologies and services. In 1985, as part of the broader, intensive national plan for administrative development, an

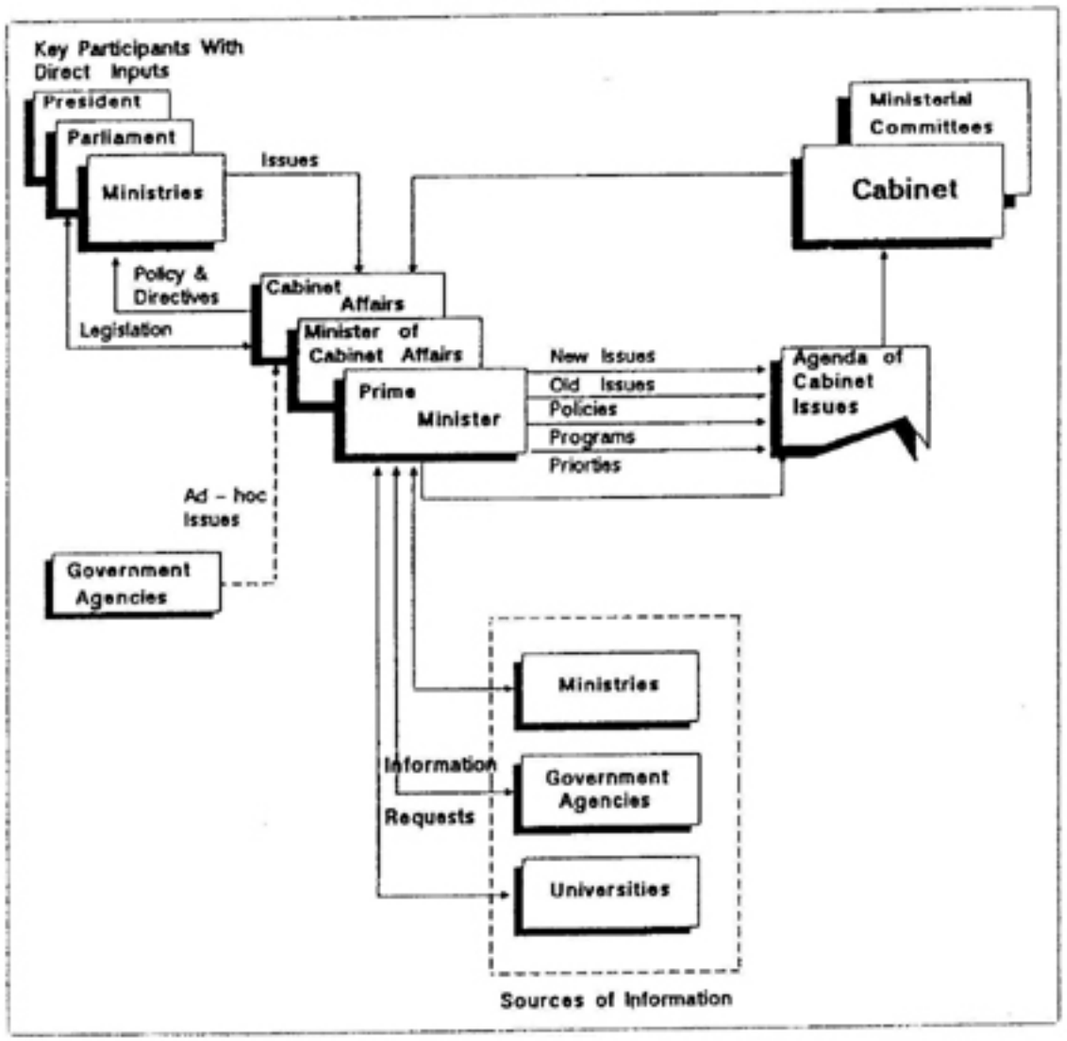

Figure 1. The Cabinet Decision-Making Process Before IDSC

information systems project for the Cabinet was initiated, and it has evolved into what is now the Information and Decision Support Center (IDSC) for the Cabinet.

The Cabinet Information and Decision Support Center

Since its inception, IDSC was guided by three strategic objectives. First and foremost was the development of information and decision support systems for the Cabinet and top policy makers in Egypt. Second was to support the establishment of end-user managed information and decision-support centers in the individual ministries. Third and more indirect was to encourage, support, and initiate informatics projects that would accelerate the development of Egyptian government ministries and agencies.

To achieve these strategic objectives, a tri-level architecture for information infrastructure and decision support was conceived:

IDSC Level
Building of IDSC base at the Cabinet to provide a focal point for Cabinet issue support, information and decision support, multisectoral analysis, and integration.

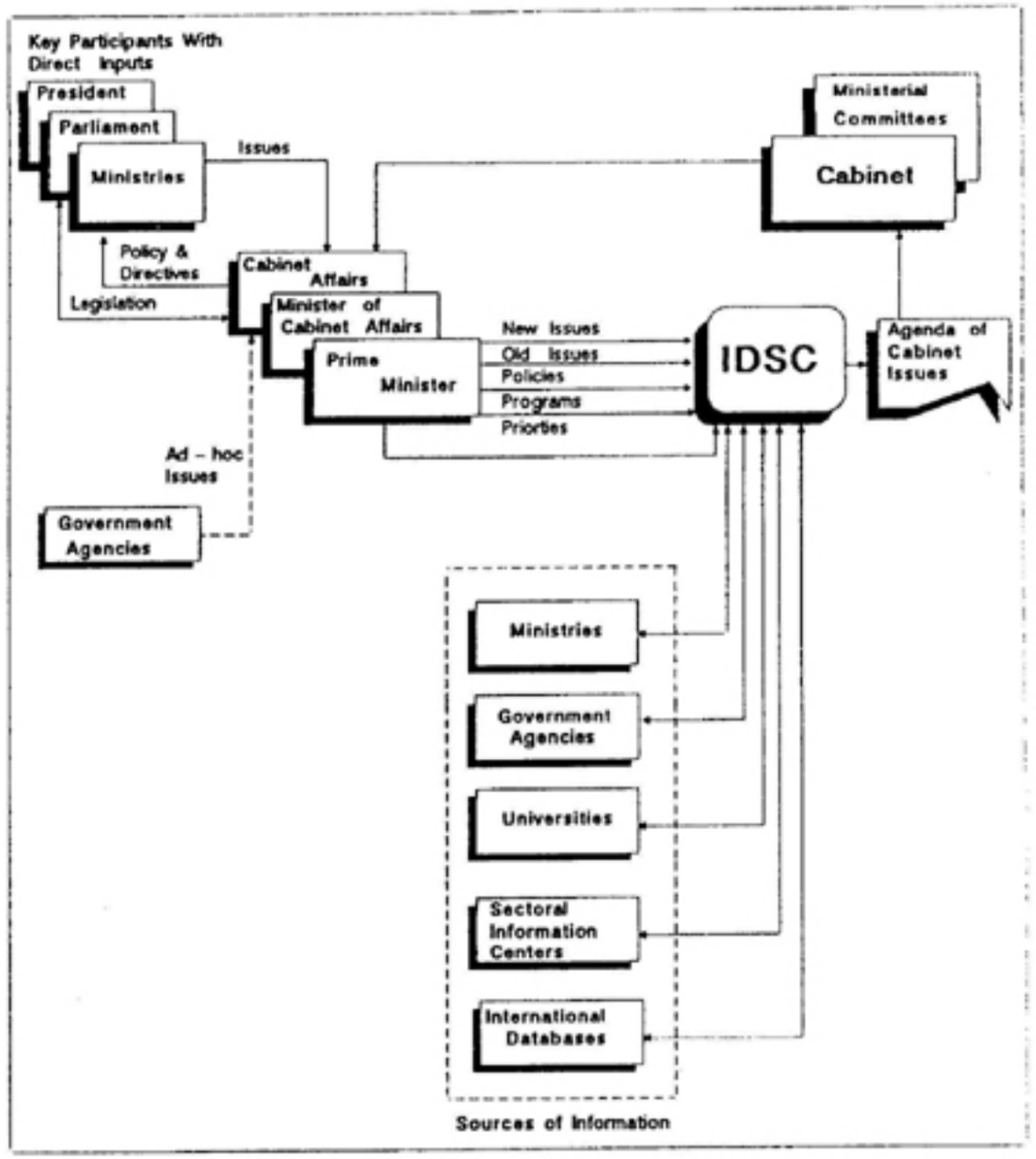

Figure 2. The Cabinet Decision-Making process After IDSC

National Nodes Level
Linking to and/or supporting the building of local sources of information and decision support at ministries and national agencies.

International Level
Extending telecommunications access to international sources of information and major databases worldwide.

As of November 1985, IDSC started providing information and decision-support services for the Cabinet and developing this tri-level architecture. Figure 2 shows the positioning of IDSC as a facilitative conduit, integrator, and expediter of information from various sources to the Cabinet. New information sources, such as sectoral information centers and international databases, have been added, and since then, the computer-based component has been growing.

IDSC has evolved rapidly from a three-person start-up in 1985 with a handful of personal computers to an organization of over 150 people by mid-1988, providing an array of information and decision-support services specifically targeted to the strategic decision-making level. It has since implemented 28 IS/DSS projects.

Learning how to effectively provide information and decision support for strategic decisions in the Cabinet context while managing rapid growth and response to an impatient and increasing service demand — and simultaneously developing the poor information and technological infrastructure of Egyptian government organizations — provided many managerial, technological, and contextual challenges for IDSC.

With respect to the design and delivery of IS/DSS for Cabinet decision making, IDSC was convinced not only that was there a need for a process different from that used for traditional DSS, but also that it was important to create an organization design that could facilitate the effective management of such services. Initially, IDSC thought the answers were "out there somewhere" and sought comparative information from similar projects in other countries. While these inputs were very helpful, it became painfully obvious to IDSC that it would have to devise both the design and delivery process, as well as the organizational design, through its own contextual learning in the Egyptian Cabinet's strategic decision-making environment.

To deal with this challenge, IDSC's strategy had several components. First, to maximize the chances of implementation success, it saw the need to improve the fit among the users in their decision making context, the form of support provided, and the technologies used. (Examples of ways the IDSC used for contextual fit improvement are shown in Table 1.) Second, it would use an iterative prototyping strategy for IS/DSS design and delivery. Third, the organizational design would emerge and develop as the process for managing the design and delivery of IS/DSS became more apparent.

The IS/DSS design and delivery process was initially conceived as shown in Figure 3. While deliberation inside the Cabinet decision-making forum revolves around issues, formal communications outside of it are expressed in terms of policies, programs, and objectives. IS/DSS project definitions are therefore handed down to IDSC in either broad, mission-driven form (such as, "We need to build a DSS to help formulate, develop, and monitor the industrial sector strategic and tactical plans"), or in a directive, data-driven form (such as, "We want you to establish an information base about all companies in the industrial sector in Egypt"). At the IDSC management level this is translated through interactions with policy makers to a set of better-articulated strategic issues around which IS/DSS are defined. Design, delivery, and institutionalization are carried out at the IDSC builder and implementer level as the process goes through iterative prototyping cycles. The tactical details of this procedure, its requisite management processes, and supporting organizational design, evolved as more was learned from each successive IS/DSS project.

Table 1. Examples of Contextual Fit Improvement Strategies Used by IDSC

Description	Effects
Reverse Distributed Processing Approach for developing technology infrastructure that started with islands of personal computers, linked them together, built a network infrastructure, and finally added a mainframe.	Bridged user-technology gap and allowed accelerated implementation of applications. There are now 110 PCs and a data network of national nodes at various ministries.
Two-Tiered Teams IDSC design team always includes two types of members: one who is technically competent (typically a young college graduate) and another who is fully experienced with the bureaucracy (an older person with goverment experience).	Bridged translation gap between DSS builders and typical bureaucrats whose inputs are sought and needed. Improved communication and minimized risk of technical failures.
Arabization of Software Linguistic and cultural adaptation of user interfaces to the Egyptian decision-making environment. IDSC has also championed incentives for a "Pyramids Technology Valley" project for software start-ups.	Bridged user-application gap. Custom applications and many standard tools (such as dBase III, Lotus 1-2-3, FOCUS) are fully arabized. Bilingual (English-Arabic) electronic mail in beta test.
Chauffeured IS/DSS Use Use of staff intermediaries for supporting senior policy makers rather than having him or her directly on-line.	Kept focus on providing support for strategic decision making rather than draining IDSC resources in supporting non-strategic office applications.

Lessons in the Management of DSS for Strategic Decision Making

Episodes from five example IS/DSS projects from the IDSC experience are presented below

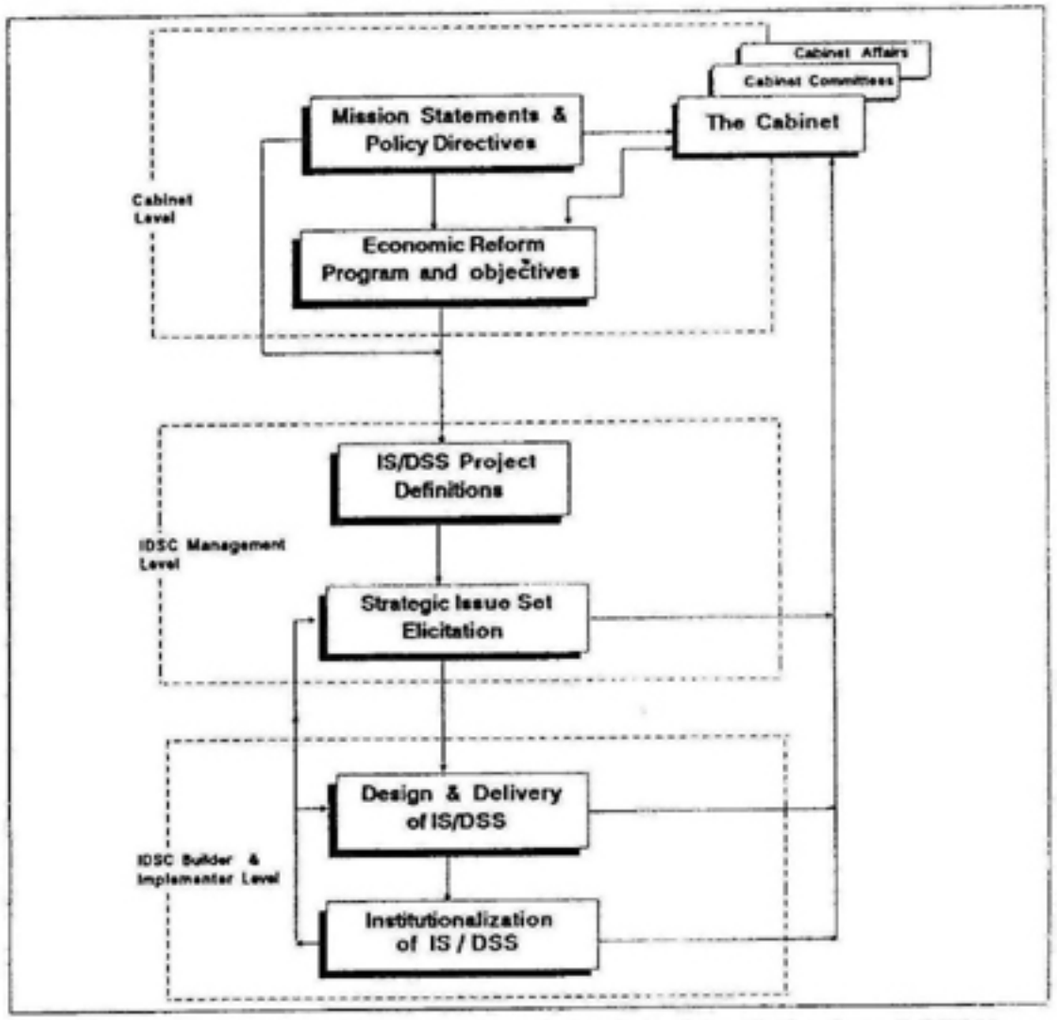

Figure 3. Supporting and Shaping Cabinet Strategic Decision Making through IS/DSS

to illustrate the generic lessons that were learned for managing the design and delivery of DSS for strategic decision making.

Illustrative case #1: customs tariff policy formulation DSS

For many years there was much Cabinet effort to overhaul a complex customs tariff structure, which encompassed too many inconsistent regulations. This concerted effort had evolved into initial agreement on a formulation of three broad reform objectives: a homogeneous, consistent tariff structure; increasing revenues to the Treasury; and minimum impact on low-income groups. In early 1986, the "new customs program" was announced in pre-final form. But six months later, despite initial agreement and good intentions, inter-ministerial debates and conflicts about policy form and perceived sectoral impacts grew. In June 1986, the Cabinet requested the services of IDSC.

A joint IDSC/Ministry of Finance "crisis" team developed an initial, PC-based DSS model using the already written tariff-reform proposal. The team comprised 32 people: two IDSC managers, two under-secretaries, six builders/implementers, and 22 data entry/validation personnel. Data was collected, with difficulty, from fragmented sources. As development progressed, the team shuttled daily to the six most-impacted ministries and met with senior policy makers to gather input and feedback and to build consensus. Initially, conflicts were sharp; discussions were heated, and one-sided theories prevailed. For example, the Ministry of Industry, wanting to encourage local manufacturing, sought to raise import tariffs on auto spare parts. The Ministry of Economy agreed with the tariff increase, because it would reduce foreign currency expenditures, while the Ministry of Finance disagreed, because it would reduce a sizeable source of customs revenue.

However, as the model became more explicit through the prototyping effort, the strategic issues were better articulated; assumptions were uncovered, and the impacts of various "what-if" scenarios for structural alternatives were demonstrated with numbers rather than abstract opinions. The focus gradually moved from objection to constructive input and considerate accommodation. After one month of intense effort, a consensus was reached and a new customs tariff policy was in place.

Lessons #1 and #2 for the Management of DSS for Strategic Decision Making

Lesson #1:

Structuring and articulating strategic issues is an integral, critical, and time-consuming portion of the design/delivery of DSS for strategic decisions. It should be labelled as an explicit "rewardable/billable" activity in the design/delivery cycle. It includes conflict resolution and consensus building and may involve shuttle diplomacy.

Lesson #2

Providing DSS for strategic decision making is most often coupled with both urgency and criticality, making crisis management a frequent mode of operation. This requires an organization design and human resource policy for the support organization that explicitly includes a crisis management component. This type of crisis management has large, unexpected variance in tempo and task (i.e., more like a fire department than an overnight package-delivery business). IDSC has added crisis management teams to its organization design. (See Figure 4.) These can be quickly put together in response to crisis requests.

Impacts: The customs tariff DSS facilitated a group decision-making process by reducing conflict and promoting consensus by clarifying the trade-offs and potential impacts of tariff structures on individual sectors and on the overall economy. It has proved to be an excellent negotiation tool, and the decision-making process was conducted with more information and less misplaced emotion. It has also made it possible to provide an equitable, uniform tariff structure. Furthermore, the originally estimated L.E. 500 million ($250 million)[1] increase in customs revenues was shown by DSS "what if-ing" to be unlikely, and that any realistic scenarios would generate about L.E. 50 million ($25 million). A year later the actual increase turned out to be L.E. 56 million ($28 million).

Illustrative case #2: production IS/DSS

Initiated in late 1985 and developed jointly with the General Organization for Industrialization (GOFI), the project was identified by the Cabinet as having two main objectives: establishing an information base about all industrial companies in Egypt; and building a DSS to help formulate, develop, and monitor the industrial sector's strategic and tactical plans. In its efforts to collect data from four main data centers (one at GOFI), IDSC encountered subject databases with incomparable structures, unstandardized data definitions, and contradictory definitional assumptions. Furthermore, examination of redundant data indicated uneven updating and unreliable integrity. Rebuilding of an integrated database was a massive effort, which detracted from decision support.

This prompted IDSC to have separate Decision Support Services (DSSV) and Project Development (PD) departments. (See Figure 4.) DSSV provides front-line decision support services to the Cabinet, and is staffed by about 25 multidisciplinary user consultants. PD would take over whenever an IS/DSS project would be initiated that required massive systems development, database building, or infrastructure development at the ministry/agency level. PD is staffed by project managers, DSS builders/implementers, and application programmers. An additional Information Resources Management department (IRM) provides technical support and manages databases. It comprises technical staff, database administrators, and systems programmers. For better inter-departmental coordination and crisis-management peak demands, there is some staff rotation among DSSV, PD, and IRM.

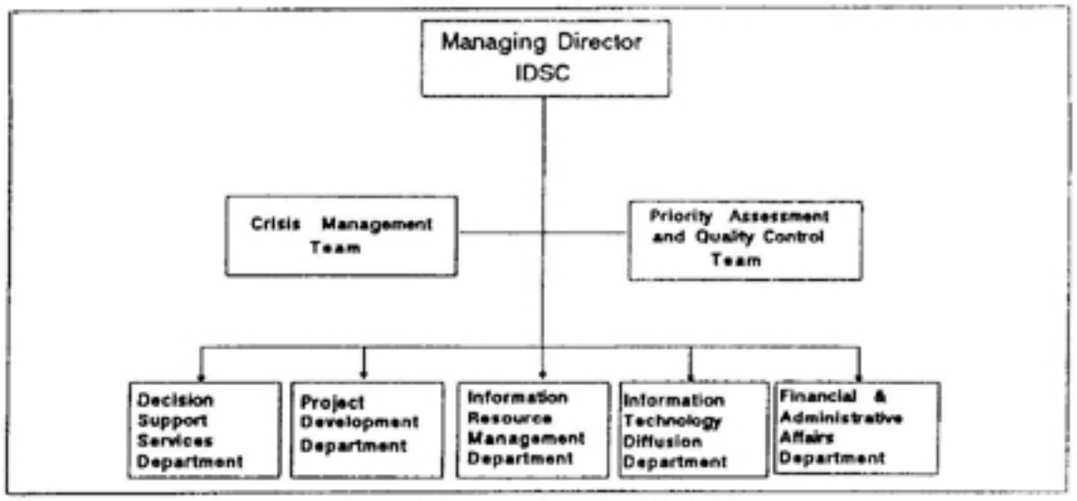

Figure 4. Organization Chart for IDSC

Lesson #3

Providing information and decision support for strategic decision making often requires much effort in building and integrating databases from diverse, extra-organizational sources. The front-line decision-support consultants should not get sucked into this activity at the expense of reduced decision support. The organizational design should reflect this.

As the issue-based structuring process moved forward, several other specific strategic issues were articulated. These focused the database-building effort on a much smaller extracted database, which was built much faster. For example, at one point, the issue of import substitution with local production surfaced as critical, and focused database building on imported industrial commodities.

Lesson #4

The structuring of one strategic issue begets other strategic issues, which can be used to focus the database building effort.

Impacts: A prototype PC-based DSS showed that 248 commodities, of which 112 were industrial commodities, represented 90 percent ($7 billion) of Egypt's 1985 total commodity imports. The DSS further revealed that, since 1974, 92 of these commodities had not been promoted locally by the Ministry of Industry. Further DSS prototypes showed that 87 of these 92 commodities could be manufactured locally with favor-

[1] One U.S. dollar equaled about two Egyptian pounds (L.E.) in 1988.

able economics. Based on this diagnosis, the national five-year industrial plan was changed by the Cabinet. This diagnostic also resulted in identifying another strategic issue — idle capacity. For each of the 87 commodities, simple bar-chart comparisons of local production, idle capacity and imports identified idle and/or under-utilized capacities for about 55 percent of public-sector industrial companies. This DSS component also allowed for the "what if-ing" of many scenarios.

Because of the initial data reliability problems, this project accentuated the importance of having explicit quality indicators for critical information in IS/DSS. It also brought to IDSC's attention the importance of decision methods that could enhance the effectiveness of information *beyond the information given*. Methods such as the examination and surfacing of critical assumptions underlying the information, transforming data from table to chart form, comparing rates of change, and sensitivity analysis of variables needed to be made more salient to users. To accentuate to users the fact that decision-making effectiveness depends on much more than information, IDSC made a distinction between information services support and decision methods support within its DSSV organization design. (See Figure 5.) Furthermore, to emphasize the importance of surfacing assumptions, IDSC has integrated them within its IS/DSS designs and includes an "assumption key" (similar to a help key).

Lesson #5

It is vital to explicitly articulate to users that effective decision making depends on more than information. For decisions surrounding strategic issues, information is usually partial, and its quality is questionable. Rather than just trying to improve informational quality, it may often be more useful to use more decision methods/heuristics.

Illustrative case #3: debt management DSS

In its massive effort to rebuild the economy, Egypt has accumulated a staggering foreign debt of $33 billion. Servicing this debt involves pegging sources of funds, renegotiation of terms and interest rates, managing payment schedules, and monitoring transactions for over 5,000 loans with a large number of creditor countries, banks, and international agencies. Previously, a decision or renegotiation on a loan payment was done on a case-by-case basis (often through telex responses). Data related to each loan was fragmented; global planning for matching sources of funds was not possible; and the aggregate debt portfolio details were not accurately known.

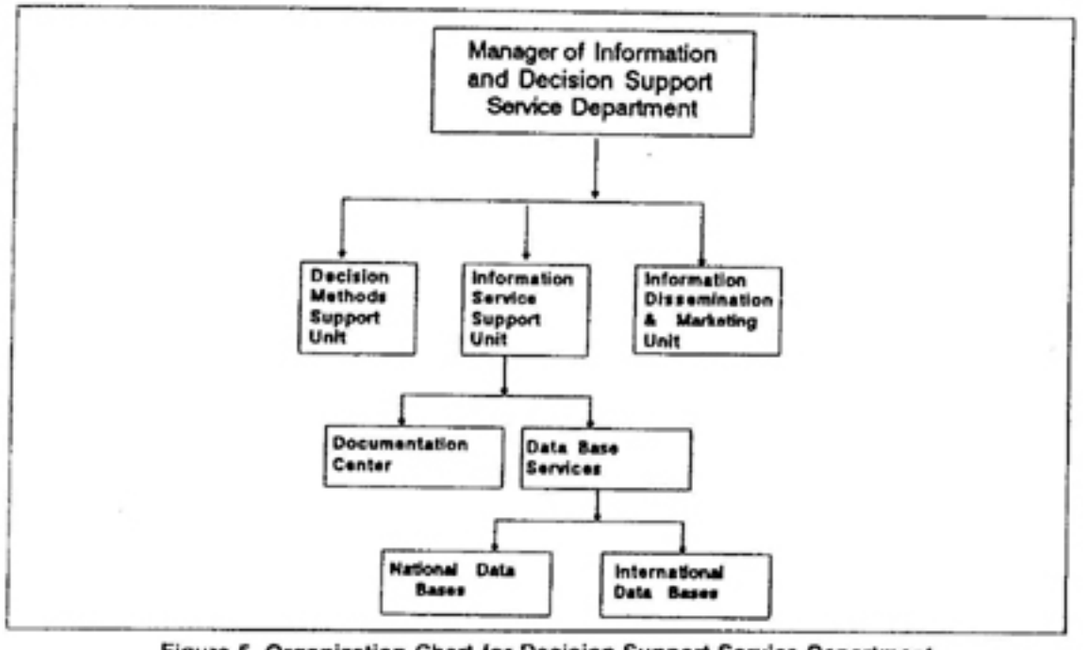

Figure 5. Organization Chart for Decision Support Service Department

A debt management IS/DSS project was established to centralize and computerize all foreign debt data in the Central Bank of Egypt and to develop a management tool to support and facilitate the registration, control and analysis of debt. Over 18 months a comprehensive, debt-validated database for government loans and a transaction-processing system for debt management was built, with DSS capabilities for examining the impacts of different scenarios. The DSS includes a multi-period, forward-looking component, which provides overall debt status in the future, and includes "what-if" functions for queries related to such things as refinancing. A rescheduling module, which allows users to dynamically track and mark status changes on any loan in the total portfolio, has also been added.

Lesson #6

If recurring decisions are to be made around a strategic issue, there is a critical need for setting up a management system for tracking and monitoring changes in the critical parameters of the issue.

The rescheduling activities carried out since late 1987 show that it is still difficult to maintain and manage the loans database, especially with dispersed negotiation for 5,000 loans. This project also experienced technical difficulties that eventually were resolved but which caused delay and aggravation. These included a classic transaction-processing situation: off-the-shelf mainframe software is adapted but does not deliver; modification efforts delayed; spaghetti code and inadequate documentation; switch to PC-based system; prototype appears quickly and works but is much too slow.

Lesson #7

The dynamic tracking component of an issue-based DSS has the usual technical demands of transaction processing systems and requires more demanding technological capabilities.

Impacts: Technical performance problems, while frustrating, did not hinder the debt-management DSS from having strategic impacts. Rescheduling negotiations with fourteen countries have been smoothly managed because of the detailed, convincing information support (such as preemptive assessment of alternatives) made available to negotiators. A key impact on the strategic decision-making process is that loans are now viewed as part of a dynamic, integrated portfolio rather than being managed on an isolated case-by-case basis

Illustrative case #4: electricity DSS

"I would like to have a computer system on my desk" was the triggering statement made by the minister of electricity and energy at a meeting in August 1987 to which the IDSC director was summoned. The seemingly symbolic statement was quickly followed by: "The cost of providing electricity is increasingly contributing to the deficit in the national budget and balance of payments. Most investment in electric power generation requires foreign currency. Besides, the current tariff structure still requires government subsidies."

It was clear that there was a set of strategic issues around which an IS/DSS was needed, and there was a top policy maker championing it. Again, the need had been expressed initially around strategic issues, rather than specific decisions. Further probing with the minister identified several critical sets of information and decision support needs, such as: daily information about the production and consumption of electricity in Egypt; ability to assess the impact of tariff changes on different income groups; ability to manage debt effectively; monitoring of large electricity-sector projects; and access to studies and legislation relevant to this sector.

Lesson #8

The issue-based approach to DSS provides a solid base for easy transition to EIS in the future.

A joint IS/DSS team was quickly formed by IDSC and the Ministry. Because of the multiplicity and diversity of data sources needed for this project, the desire to simultaneously build an internal Information and Decision Support Center inside the Ministry of Electricity, and the minister's expressed long-term interest in having EIS-like capabilities, IDSC saw a much greater need in this project to focus on the process of managing the delivery of the system with its requisite support

infrastructure rather than just the design of the IS/DSS itself. However, the process by which this effort would be managed was prototyped and adjusted on the fly: the Ministry team would be responsible for gathering data around the issues identified by the Minister; the IDSC team would be responsible for issue structuring, DSS development, hardware selection, training, and managing the process. But these roles changed as the project progressed and adapted to the contextual requirements of DSS implementation.

Lesson #9
It was not only DSS design that could be prototyped; the management of delivery could be prototyped as well.

A working prototype was developed, methods for providing information support services were devised, and decision heuristics to assess the impact of various tariff structures and production and consumption patterns were implemented. As the design and delivery activity proceeded, a related strategic issue of crisis proportions surfaced: drought in the source regions of the Nile River and its overuse in irrigation were causing peak hydroelectric power generated by the Aswan Dam to drop precipitously; $500 million was needed to quickly build three generating stations. There was now a crisis dimension that had appeared suddenly. Furthermore, the strategic issue had now drawn in the Ministry of Water Resources as a critical stakeholder in DSS design. The process by which the effort was managed also changed at this point: a team of six people was selected from the Ministry as a core group for starting its own information and Decision Support Center, and seven user committees were formed, each headed by an undersecretary, to manage data collection and analysis.

Impacts: The DSS is still evolving and so is the process by which it is being managed. The management of the DSS-delivery process had to be changed when two of the six undersecretaries were unwilling to accept the DSS. However, the impacts of the DSS have already been felt. The water-level crisis is in full focus and much better understood; The DSS has also helped to assess the different tariff alternatives and the impact of each on citizens and total revenue, and a new electricity tariff has been in place since January 1988.

Case #5: document-based DSS

Various IDSC projects accentuated the role of textual documents as key sources used in the strategic decision-making process. For example, the Legislation and Decrees Project was initiated to respond to the access problems related to the retrieval and classification of all Egyptian government legislation and decrees since legislation was first passed in Egypt in 1824. To date, the project has classified all legislation and decrees from 1957 to 1987. This document database has been used in conjunction with other DSS, such as the electricity DSS. IDSC has established a fully staffed documentation center as part of its Information Support Services unit. (See Figure 5.)

Lesson #10
Providing decision support for strategic decision making will require much textual and document-based information sources. Organizational design should reflect this capability.

Assessing Impacts and Value

In general, DSS benefits are often very uncertain and elusive to assess. This is especially true in the Cabinet case, with a prototyping approach where development is evolutionary, and when benefits can appear very early (while structuring an issue) or much later (crisis response in a future negotiation). The on-going, group strategic decision-making context, with multiple interrelated DSS in shifting environments, makes it even more so. Orthodox cost/benefit analysis will not work. At the strategic level, however, the leverage of a few major, obvious "hits" can also justify the whole effort many times over. In the preceding section, some of the case studies illustrate the enormous magnitude of a few "hits." IDSC has implemented a total of 28 IS/DSS projects for the Cabinet, and while some projects may not have been as successful as others, and in some cases the benefits were not as obvious, the cumulative leverage that IS/DSS have provided through the obvious "hits" has been estimated by the Cabinet to be at least in the tens and probably in the hundreds of millions of dollars. For the Cabinet, the leverage is now overwhelmingly clear.

But even without the track record of a few big hits, the *potential leverage* is sufficient to justify the investment in IS/DSS to support strategic decision making. It is difficult to ignore the potential leverage of effective IS/DSS for debt management when negotiating a 1 percent interest rate difference on a $33 billion debt amounts to a whopping $330 million. In contrast, IDSC's total operating costs (excluding overhead borne by the Ministry of Cabinet Affairs) have been around $2 million. In order to enable IS/DSS for strategic decision making to be successfully delivered in any organization, that balance must be very clear to top management; otherwise, it will be difficult to generate strong and sustained top-management commitment. The IDSC project could not have gone forward without that understanding and the strong commitment and support from the minister of cabinet affairs. The IDSC director reports directly to him.

The "bottom-line" impacts of IS/DSS at the Cabinet level have been mediated through process changes and qualitative valuation criteria. In the examples given in the preceding section, the valuation criteria in each case were different, usually qualitative, context-dependent, and in many instances they blurred the difference between process and outcome: quicker and more effective consensus on a group decision; uncovering hidden assumptions; better crisis response; better understanding of the interaction between industry forces; preemptive generation of alternatives for better negotiation; and identification of new strategic issues. Cumulatively, these impacts have also changed the way that the Cabinet views the role and value of IS/DSS: there is a deeper realization of their potential leverage for helping the decision-making process as evidenced by the increasing requests and resulting growth of IDSC services.

Finally, this experience provides convincing evidence that, contrary to stereotypical depictions, computer-based DSS do not necessarily have to move the decision-making process away from emotive deliberation. Rather, the IDSC management process for the design and delivery of issue-based DSS accommodated and took advantage of (rather than denied) the social, visceral, political, and intuitive aspects of the strategic decision-making process. The metaphor used at IDSC is that the group decision-making forum has changed from a "darkened room" to a "more illuminated one" where assumptions are more visible, potential impacts are better seen, quality of information is made more explicit, and competing scenarios can be made clearer. This extra illumination still allows emotive views to be aired and the intensity of values and commitments to be expressed and considered; but now it takes place with less misplaced emotion and in an information context in which more effective, strategic decision making can be realized.

Managing the Design and Delivery of Issue-Based DSS

This work has resulted in a generalized procedure for managing the design and delivery of issue-based DSS for strategic decision making. It evolved through lessons learned from IDSC's cumulative experience with 28 Cabinet IS/DSS projects. In addition, the procedure was more formally articulated and the process expertise more thoroughly captured through a six-day participative workshop in late 1987 attended by over 20 professional IDSC staff members. (See El Sawy and El Sherif, 1987.)

Strategic decision making is the Egyptian Cabinet's major activity, thus affording an opportunity to observe the process with an intensity that is unequalled in more conventional settings. Coupled with the Egyptian cultural penchant for debate around focal points (rather than talking directly at them), the setting accentuated the notion that strategic decision making primarily revolves around issues rather than decisions. The inadequate reliability of the information infrastructure coupled with the need for crisis response led to the idea of prototyping the delivery process as well as the design. While the setting's cultural and environmental uniqueness helped to shape the approach, the authors believe that both the tactical essence of the procedure and its underlying concepts are transferable to other types of organizational settings.

Parallels are easily mapped from the Cabinet to corporate settings, whether for executive roles, IS management, issue "down-loading/up-loading" between levels, or potential interaction between strategic decision making and IS/DSS. (Compare Figure 6 to Figure 3.) The use of issues management is not alien to corporations (King, 1981) and has also been applied to planning for the MIS organization (Dansker, et al., 1987). While strategic decision making in the corporate world may be more closely linked to com-

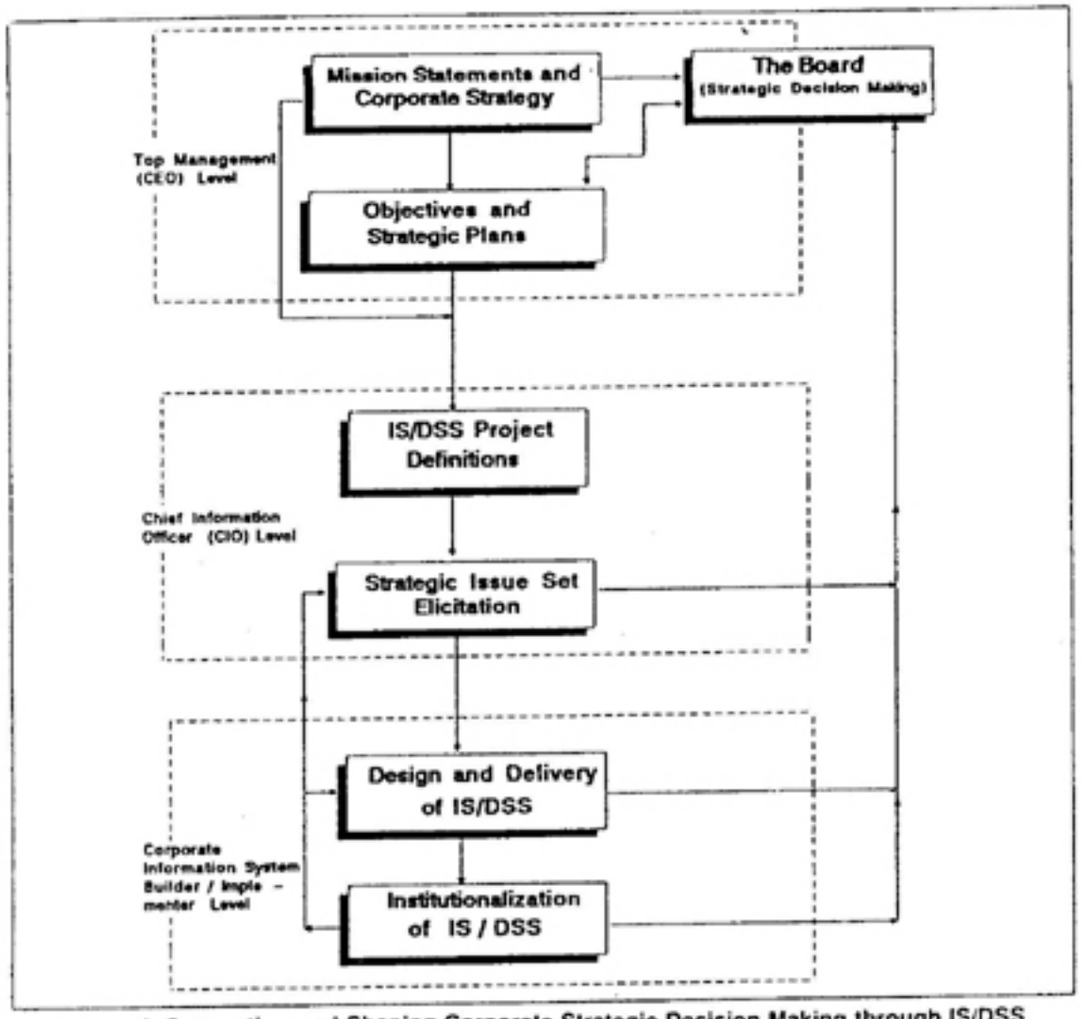

Figure 6. Supporting and Shaping Corporate Strategic Decision Making through IS/DSS

petitive advantage, this does not seem to change any of its process features.

Figure 7 shows the basic building blocks of the procedure for managing the design and delivery of issue-based DSS for strategic decision making; Table 2 illustrates its tactical essence. The procedure has the following distinctive features:

- it is *based on issues* rather than primarily on decisions.
- it is a *management process* rather than solely a systems development lifecycle.
- it is a strategic *issue structuring front-end*, which is sizeable, explicitly identifiable, and consequently rewardable and billable.
- it explicitly *distinguishes between information support services and decision support services*.
- in addition to prototyping the DSS design, it also *prototypes the DSS delivery process*. Its "delivery" stance implies a service view of implementation with continuous user support. This maximizes contextual fit and accommodates crisis response.
- as part of the institutionalization process for the DSS, it includes setting up a *dynamic tracking back-end* for monitoring shifts in critical issue parameters. This is key for recurring decisions and also makes transition to EIS much easier.

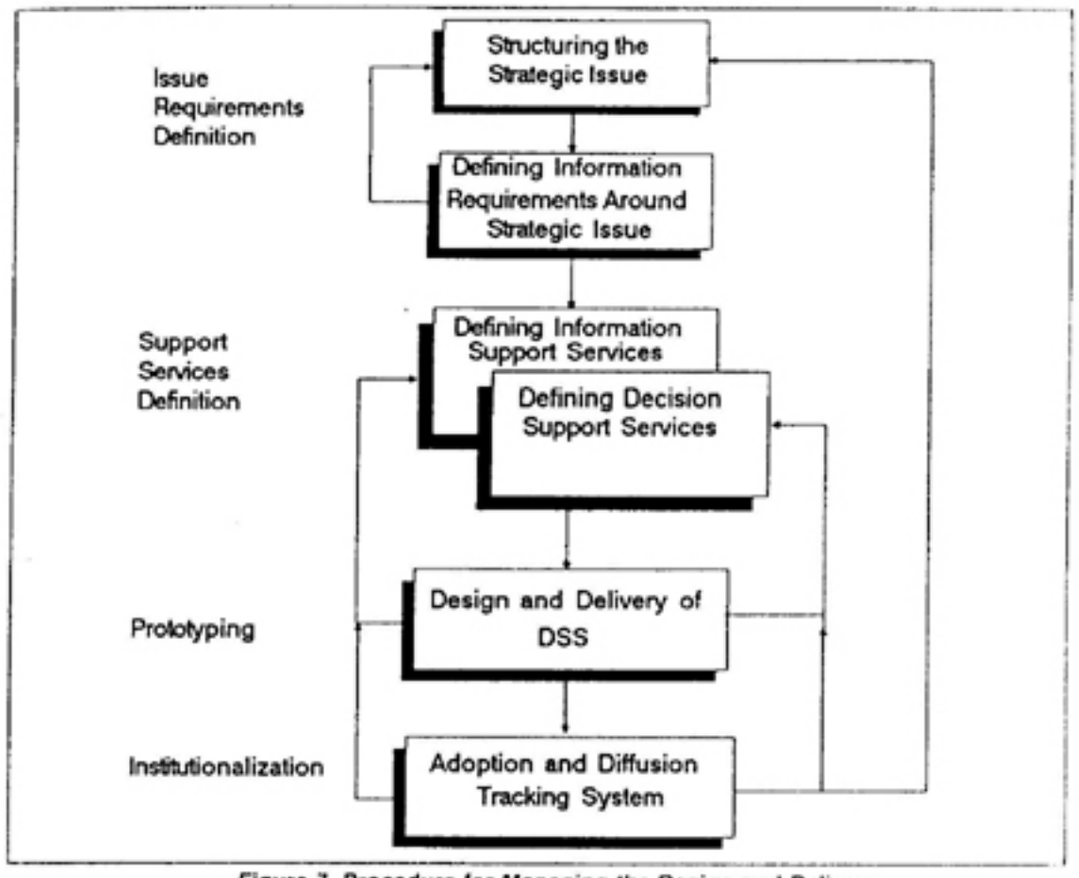

Figure 7. Procedure for Managing the Design and Delivery of Issue-Based DSS for Strategic Decision Making

The procedure as shown in Figure 7 and elaborated in Table 2 is highly iterative and consists of both nested and intersecting process loops:

- ISSUE REQUIREMENTS DEFINITION LOOP: Cycles between structuring the strategic issue and defining the requirements around strategic issues.
- SUPPORT SERVICES DEFINITION LOOP: Cycles between defining information support services and decision support services. In combination, this component roughly parallels Sprague and Carlson's (1982) ROMC approach.
- PROTOTYPING DESIGN AND DELIVERY LOOP: The design prototyping iterations are nested in a delivery process envelope that is also prototyped. This component iterates with the support services definition loop.
- INSTITUTIONALIZATION LOOP: Encompasses both organizational adoption and diffusion, including the setting up of an issue-tracking system. This component iterates with all other loops.
- EVALUATION AND PRIORITIZATION ENVELOPE (not shown in Figure 7): The procedure is enveloped by continuous evaluation and prioritization, which enable shifting and or intensifying effort and resources among issues and/or DSSs as appropriate.

Comparing the Conventional and Issue-Based DSS Approaches

It has been shown how the issue-based DSS approach has been successfully implemented in

Table 2. Tactical Essence of the Procedure for Managing the Design and Delivery of Issue-Based DSS for Strategic Decision Making

Outcomes	Typical Activities	Representative Methods and Tools	Typical Key Participants
1. Structuring the Strategic Issue			
reformulated issue emergent objectives issue articulation stakeholder consensus	assumption surfacing negotiation conflict resolution stakeholder identification	shuttle diplomacy interviews group meetings brainstorming and idea-processing tools empathy	issue stakeholders key decision makers CIO
2. Defining Information Requirements Around Strategic Issues			
critical information critical assumptions decision scenarios crisis scenarios	defining initial information needs determining information quality requirements defining information format requirements	modified variants of extended CSF methods Delphi methods interviews	key decision makers DSS user consultants staff intermediaries
3. Defining Information Support Services Around Strategic Issue			
scope and type of information support services that need to be provided	providing access routes to information integrating information from multiple sources providing information views	data dictionaries bibliographic searches external information utilities	staff intermediaries DSS user consultants DSS builders
4. Defining Decision Support Services around Strategic Issue			
scope and type of decision support services that need to be provided	providing "what-if" analysis capabilities scenario generation	modelling software assumption surfacing tools	staff intermediaries DSS user consultants DSS builders
5. Prototyping the Design and Delivery of DSS Related to Strategic Issue			
DSS delivery methods working DSS prototypes	infrastructure development database development DSS design and delivery	prototyping tools	key decision makers staff intermediaries DSS user consultants DSS builders toolsmiths
6. Managing the Institutionalization of DSS			
DSS adoption DSS diffusion dynamic tracking system	cultural adaptation user support	training workshops newsletters exception reporting	DSS consultants trainers staff intermediaries

response to the need for supporting strategic decision making at the Cabinet level in Egypt. A procedure for managing the design and delivery process for such DSS has also been presented. In Table 3, a brief comparison of the conventional and the issue-based approach to DSS is provided. The table may be useful to both information systems practitioners and researchers in clarifying the advantages and limitations of the issue-based approach to various situations and organizational settings. It is also meant to suggest how the issue-based view of DSS may be the missing stepping stone to advancing the state-of-the-art in the definition, design, and delivery of EIS. To use a popular analogy, similar to television sets that are cable-ready and VCR-ready, issue-based DSS are "EIS-ready."

Conclusions

The use of information and decision support systems has significantly leveraged the strategic decision-making process in the Egyptian Cabinet. Ministers and senior policy makers have increasingly realized that information systems and information technologies are not convenient luxuries for times of prosperity but rather can be vital necessities in times of turbulence and adversity.

Strategic decision making is a very messy process, but it can still be made more effective by information and decision support systems. However, the IDSC/Cabinet experience suggests that it may be necessary for us to change our conventional views about DSS *and* our ways of managing them if we are to make more progress in the strategic decision-making arena. The issue-based view that has been presented here and its accompanying design and delivery procedure is one way of doing that.

Finally, it is hoped that this story provides the international information systems profession with a compelling example to show that there are things that can be learned to advance the field

Table 3. Comparing the Conventional and the Issue-Based DSS Approach

	Conventional	Issue-Based
Focus	• on decision maker • on single decision • decision making • alternatives generation	• on issue • on groups of interacting issues • attention focusing • agenda setting
Favored Domains	• tactical and operational decisions • one-shot decisions • functional applications • departmental applications	• strategic decisions • recurring strategic decisions • cross-functional applications • trans-organizational applications
Design and Delivery	• promotes customization to individual decision maker • interaction between decisions not incorporated • prototypes design • design approach becomes the system	• promotes consensus around group issue • integration and consensus drives process • prototypes design and delivery • delivery approach becomes the system
EIS Readiness	• no tracking component • emphasizes convergent structuring • major transformation	• incorporates tracking component • balances divergent exploration and convergent structuring • easy transition to EIS
Emerging Leveraging Technologies	• expert systems	• idea processing and associative aids (hypertext) • multi-media connectivity platforms (video conferencing) • object-oriented languages

and its practice through information system implementations in international contexts where there are less-advanced technological infrastructures.

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