# DECISION SUPPORT SYSTEMS IN INFORMATION TECHNOLOGY ASSIMILATION

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## ABSTRACT

*The potential suite of decision support system (DSS) applications deployed by organizations is dynamic and change with advances in computer technology. An understanding of DSS applications is important in planning organization strategy or creating a roadmap that encompasses these changes. This research effort examines the definition of DSS, the assimilation of information technology in organizations, and the assimilation dynamics of DSS. As DSS tools are assimilated into applications of an organization, they often enter the organization as ad hoc DSS applications at the strategic planning level. The technology transfer continues until these tools are embedded in large-scale applications that exhibit the characteristics of structured decision support (SDS) or transaction processing systems (TPS). Therefore managers and researched should view them as a SDS/TPS and not a DSS. Recognition of an assimilation roadmap assists in this technology transfer and recognizes this is okay – it is an acceptable means of making this transfer.*

Keywords: DSS, decision support systems, information technology assimilation, software development

## INTRODUCTION

When is a Decision Support System (DSS) not really a DSS? Frequently, an application, that involves decision making in any manner, whatsoever, is often classified as a DSS. Advances in computer technology are dynamic and impact information system applications including DSS. The result is a suite of DSS applications that is dynamic and constantly changing. This makes it virtually impossible to lock such changes into a static set of DSS applications. Clearly, the nature of DSS changes in parallel with the advances in the development of computer technology. Kren [9] reports that Moore's Law (doubling of computer power every 18 months) is on track for at least the next five years. This would indicate that information systems technology will continue its advances in new and diverse directions. While some DSS applications have become widely accepted, others are likely to ebb and flow with these technological changes. This dynamic nature of information systems technology, in general, and DSS applications, in particular, makes it difficult for chief information officers and other managers to clearly define a fixed suite of DSS applications. However, the identification of DSS applications is important in planning organizational strategies for the deployment of information technology. This research analysis sets forth a framework for that information technology transfer, which involves the continuing evolution and application of DSS tools. The purpose is to examine a planning perspective for the future deployment of DSS tools and applications as enabling information technologies evolve. A planning framework for information systems professionals needs to recognizes a technology assimilation roadmap with a role for DSS. The analysis is presented by

first examining the definition of DSS, then by considering the information technology assimilations stages and dynamics, and last by summarizing the DSS and technology assimilation relationship.

## DEFINING DECISION SUPPORT SYSTEMS

An operational definition of a DSS is important in identifying and categorizing DSS tools and applications for the purpose of examining a technology assimilation roadmap. For purposes of this analysis, a DSS is defined as the use of the computer to:

(1) assist managers with their decision process in semi-structured tasks;
(2) to support, rather then replace managerial judgment; and
(3) to improve the effectiveness of decision making rather than its efficiency. (Keen and Scott Morton [8] p. 1).

Others [10, 12, 13] have also provided definitions for a DSS. Although some minor differences exist in these other definitions, an examination of those definitions reveals that overall they support the definition set forth initially by Keen and Scott Morton [8]. Therefore, Keen and Scott Morton's definition is the operational definition used for this analysis. They provide additional clarification of a DSS as follows:

> The key question for anyone working on a DSS is: "What specific decision or decision process are we trying to support?" The decision may be repetitive and ongoing or a one-shot situation. The decision support focus assumes that the problem the manager is facing is not trivial and that it cannot, at this moment be automated. This perspective requires the development of methodological tools to examine key decisions of managers and to define the information that can or should be made available to them. … Of course, over time, as our level of understanding increases, it may be possible to take some of the problems that we now consider fuzzy and systematize them so that they can be delegated to a computer or a clerk. An obvious example of this process is credit scoring. Most banks and loan companies now have simple procedures, based on actuarial data and supported by credit reports that replace the prior judgment of a senior loan officer.
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> Since the problem can only partially be structured, and since managers grow in their understanding and needs over time, a DSS must constantly grow and evolve as the user adapts and learns. This is their very nature and implies much for the construction of such a system, the kind of software used, and more importantly, the way it is implemented and maintained in the organization itself. (p. 58-59)

Gorry and Scott Morton [7] provide a context for the semi-structured characteristic of this DSS definition. They relate the work of Simon and Newell to a framework of structured and unstructured decision-making processes. A fully structured problem is one where all three decision-making phases – intelligence, design, and choice – are structured. A fully-unstructured problem is one where all three decision-phases are unstructured. A semi-structured problem is one where one or two, but not all, of the decision-making phases are unstructured. They define information systems that are largely structured as Structured Decision Systems (SDS), whereas

those that are semi-structured or unstructured are DSS. Information handling is excluded from this structured/unstructured categorization. An information handling activity in an organization is one in which considerable computer time is devoted to straightforward data handling with no external decisions involved, such as payroll processing. Both the SDS and information handling processes are largely the routine data processing or transaction processing system (TPS) activities. This viewpoint is reinforced and summarized by Power [12, p. 9] as any information system that is not a SDS/TPS is frequently labeled as a DSS. Therefore the definition of a DSS is qualified by (1) the categories of use and (2) movement along the structured/unstructured continuum. Furthermore, DSS can be divided meaningfully into two categories: institutional DSS which deal with decisions of a recurring nature (repetitive), and ad hoc DSS which deal with specific decisions which are not usually anticipated or recurring (one-shot) [5, 8, p.58] "The shifting of problems toward the structured end of the spectrum has been in progress since management began." [8, p. 92] The advent of DSS facilitates rather than retards this movement. The evolution and migration of a DSS into embedded functionality of a SDS/TPS is a strong indicator of a shift to the structured end of the spectrum.

For purposes of this analysis, the DSS application is distinct from the DSS tool. The DSS tool, also known as a DSS generator, is the computer software that is used in the creation of a specific DSS application. The tool is the enabling technology. The application is the system that actually accomplishes the work and supplies a decision maker with the required information. The DSS area has undergone profound structural changes including its technology tools [6]. Today's DSS utilize a variety of computer-based tools that make it possible to create more advanced DSS applications [11]. An information system tool that at one time is used with a primary focus for building DSS may at a latter time find its use as primarily SDS/TPS. Because the tool was initially created for use in building a DSS tool does not infer that all information systems subsequently created using that tool are DSS. The fundamental definition of a DSS needs to be applied in determining whether or not the application is, in reality, a DSS.

## INFORMATION TECHNOLOGY ASSIMILATION STAGES

Information systems managers should expect that as new computer technology is created or evolved it will often be assimilated in organizations in a variety of ways. Applegate, McFarlan, and McKenney [1, p. 226] summarize a process for assimilating emerging information technologies in organizations. This consists of a series of stages through which new technology is identified, assimilated, and institutionalized. They described the four stages of (1) technology identification, (2) technological learning and adaptation, (3) rationalization/management control, and (4) maturity/widespread technology transfer. Technology identification examines new information systems tools, tests those tools, and leads to a determination of the desirability of acquiring the technology. Technological learning and adaptation involves gaining knowledge about how to deploy the technology in information systems opportunities beyond the initial, evaluative projects. Rationalization/management control encompasses continued evolution of the application of the technology and development of controls for guiding the design and implementation of systems that apply these technologies. Maturity/widespread technology transfer occurs when the technology is embraced throughout the organization. During technology identification, pilot projects are often undertaken at the strategic planning level of the organization, especially where a single project is undertaken for a key executive sponsor. When

the maturity/widespread technology transfer has occurred, the technology is used across all organization levels and particularly at the operational control level by many users in the organization. Similar to the development of other information systems tools, these stages of assimilation play an important roll in the tool kit for developing, deploying, and applying DSS in organizations.

The assimilation of information technology tools can drive a tool from being primarily used as a DSS tool, when it first enters an organization at Stages 1 and 2, to a tool that is primarily a SDS/TPS, when it reaches Stage 4 of maturity/widespread use in an organization. With this assimilation, the realm of the SDS/TPS has expanded. Primary indicators that DSS technologies have reached Stage 4 and have become embedded in a TPS are the number of users of the system and how system support is provided. This expansion has been present since the first data processing application were begun in the 1950s. Increases in computing power, at decreasing costs for that processing capability, is a key driver in pushing technology and tools from a primarily DSS usage to SDS/TPS applications. This evolution is as likely to occur as the seasons are to change and Moore's Law [9] continues to describe the pace of computer technology evolution. For example, consider the assimilation of spreadsheet software, a popular DSS tool. In the early days of VisiCalc, few personal computers existed in organizations. VisiCalc was applied primarily in the support of executives at the strategic planning level (Stage 1). As this technology evolved together with an organization's use of the technology, the Microsoft Excel spreadsheet (or its equivalent) is now on the desktop computer of virtually every one of these computer users, regardless of their level in the organization (Stage 4). So, a spreadsheet tool, that was once, and initially, a tool for senior level management, is now an everyday tool for all users of desktop computing. When information technology introduced at Stage 1 as a DSS application tool has reached stage 4 based on its usage pattern with the organization, then the resulting system should be recognized for what it has become considering that usage. That is, a SDS/TPS rather than a DSS application.

## ASSIMILATION DYMANICS

As new technology is developed and progresses through the stages of assimilation, the technology evolves from initial introduction to wide-spread or institutional use. A portion of the technology introduced with a DSS is likely to become embedded in a SDS/TPS. A technologically enhanced information system (TEIS) is a SDS/TPS that contains embedded tools and techniques that have evolved from Stage 1 through Stage 4 in a DSS development. According to Power [12], "DSS differ in many ways from operating systems that process transactions. For example, a popular system that has been widely implemented is called Enterprise Resource Planning (ERP). ERP is not a DSS even though the term suggests that decision making and planning will be improved. In general, ERP is an integrated TPS that facilitates the flow of information between the functional areas of a business." (p. 8) In a similar manner, many of the systems that have been categorized as DSS are TEIS that suggest decision making is embedded in the information system. This is a natural progression of DSS tools into SDS/TPS tools. What was once recognized as a cutting-edge DSS becomes just an "everyday" SDS/TPS. Managers are better off planning on having one set of tools today and a completely different set of tools five years from now [3]. There is no reason to expect this progression in enhancing the SDS/TPS processing systems will end any time soon.

Information system applications can be considered on a continuum from SDS/TPS to DSS. Figure 1 illustrates technology transfer where an ad hoc DSS provides a means for facilitating the activities of assimilation Stages 1 and 2 and provides an environment where a project is undertaken for a key executive sponsor. Then the DSS tool is used at lower levels within the organization. This greatly expands the user base into that of large scale DSS, which typically exists with an institutional DSS. Now, the DSS has evolved into a SDS/TPS in the manner in which it is deployed and maintained within the organization. The enabling technology has reached Stage 4 of maturity/widespread technology transfer. The application developed and deployed using the enabling technology of the initial DSS tool has evolved into an application, which is a TEIS and exhibits the characteristics of a SDS/TPS.

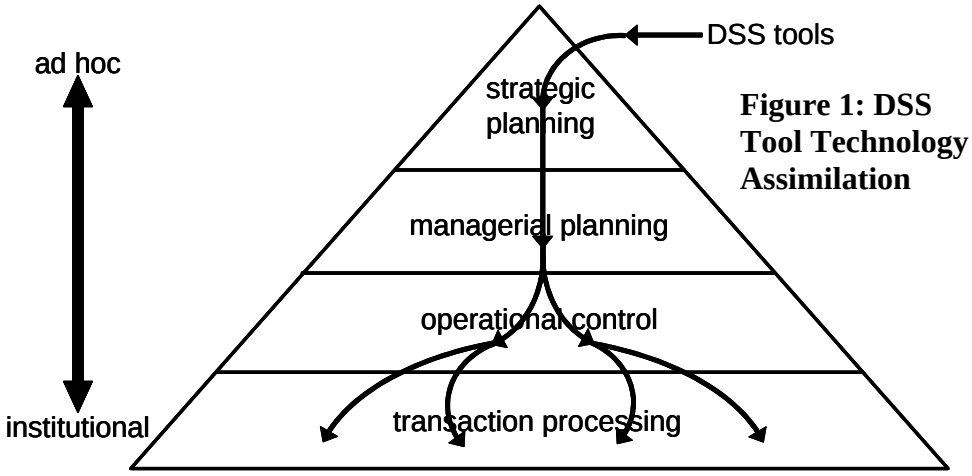


**Figure 1: DSS Tool Technology Assimilation**

The DSS and SDS/TPS distinction is most important because there are several key differences between the development and maintenance of a DSS as compared to those of a SDS/TPS [8, p.92]:

1. The people involved in building DSS need to have different skills and attitudes from those building systems for SDS/TPS.
2. The technology that supports DSS is different from the maintenance and efficient operation of SDS/TPS.
3. The models that support managers' decisions in DSS may be substantially different from optimization algorithms used with SDS/TPS.
4. The processes by which DSS are developed follow an ongoing evolutionary method that is different from the delivery of a final product of a SDS/TPS that is used repetitively.

Although technology has advanced, the characteristics remain valid. Consider a category of DSS delineated as executive information systems (EIS), which have had their capabilities embedded into the SAP R/3 System enterprise software for sometime [2, p. 319-320]. Enterprise software, also known as ERP software, is software that primarily provides an organization with an integrated suite of TPS functionality. This is an indicator of embedding DSS technology into TPS and illustrates dynamics of technology assimilation. Here, the ERP software is a TEIS that contains an EIS capability, which was initially developed as a type of DSS. But, the SAP R/3 System is not a DSS.

Another example of a TEIS is the American Express application of expert system technology to real-time credit authorizations that make judgment calls [4]. Expert system tools are among the primary tools for building a specific DSS. This example demonstrates the development,

deployment, and support of a TEIS. When DSS tools are applied in this manner to a large scale DSS, they align with and require the implementation and maintenance processes used with SDS/TPS. The ongoing support and maintenance shifts from that of a DSS to that of a TPS. As a consequence, this example is not a DSS.

Wells and Hess [14] describe a data warehouse DSS (DW-DSS) that is used at a financial services organization. They describe this as a large-scale DW-DSS, which classifies it as an institutional DSS. This DSS application is used by 1,500 personal financial advisors. Each week it provides a list of 60 customer leads with a product/service recommendation for each lead. This is identified as a customer relation management (CRM) application for the organization. The application does not provide information that supports decision-making by these advisors. If an advisor does not feel the recommended product is appropriate, then the advisor uses other external systems and resources to formulate a different recommendation. Based on the definition of a DSS, the system should provide the information that supports the decision-making. This reported DW-DSS provides results that are structured and establishes it as a SDS. A data warehouse tool is used in the development of the system, and this tool is frequently used as a DSS tool. However, this use of the tool appears to result in a SDS rather than a DSS. It does represent a TEIS that is a SDS, but not a DSS.

The assimilation of DSS tools into SDS/TPS makes some of the attributes of a DSS a moving target. Is this good or bad? If an organization's managers are provided with better information that they require to support their activities, this should be good. What it's called doesn't matter. However, this increases the difficulty in clearly specifying where a SDS/TPS ends and a DSS begins. A fuzzy middle ground exists that is constantly shifting as technology allows both the SDS/TPS and DSS applications to expand.

## SUMMARY AND CONCLUSION

DSS is information technology that is assimilated in organizations in a manner similar to the assimilation of other information technologies. However, when a technology initially introduced as DSS technology reaches maturity or widespread technology transfer, this initial deployment as DSS tools will have likely completed a migration into SDS/TPS technology. Information systems managers and researches should expect that as new computer technology is created or evolved, it will often be deployed in organizations as a DSS tool that enters the organization at the strategic planning level. Once it proves to be successful there, it is likely to be used in DSS applications at lower levels of the organization hierarchy, where they become large scale institutional DSS with all the characteristics of a SDS/TPS. The DSS tool will have evolved as an integral part of a SDS/TPS, and the resulting application should be recognized as such, leaving behind the moniker of an "institutional DSS." This integration into large-scale applications then requires the same system development and maintenance needs as other existing large-scale application. The relationship between the system builders and users is now the same as for a SDS/TPS, and such assimilation is an entirely acceptable outcome. As a result, the suite of current DSS tools and applications are dynamic and must be adaptable to this changing progression of information technology for use in the construction and deployment of DSS. The recognition of this assimilation provides guidance or a roadmap for changes in the maintenance and support as a TEIS that has evolved from a DSS to a SDS/TPS. DSS applications then get back to their basics and retain the attributes of their original definition that focuses on semi-

structured and unstructured decision making activities. Clearly, every application that uses a new and emerging information systems tool should not be immediately labeled as a DSS.

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