Decision Support Systems and Artificial Intelligence Technologies in Aid of Information Systems Based Marketing

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Abstract] The primary goal of this study is to predict the next logical and practical approach in the use of advanced Decision Support Systems (DSS) and Artificial Intelligence to find and evaluate markets for prospective products. In addition to determining these markets, DSS will then be used to predict the success of the market and other product lines that can be brought to those markets, making companies more successful in the structuring of marketing models and product lines.

Keywords] Decision support system; artificial intelligence; marketing; DSS; marketing model; IST; IS; global marketing

Introduction
Information Systems Technology (IST) is becoming a more prominent part of global marketing. With the aid of IST, companies can become competitive in all phases of customer relations (Ives and Learmonth, 1984). The use of information technology for finding markets is expanding, enabling companies to keep up with prospective markets in today’s dynamic economy. IST accomplishes this feat by helping marketing departments determine targets for their products and charting the most effective way to cover the largest market in the shortest amount of time. They also enable marketing to establish trends so that new products coming to market can be quickly evaluated and decisions made on the best placement for these products.

Information Systems (IS) today are designed with reusability in mind. They span multiple markets, enabling companies that design products to sell them to several different companies interested in gaining an edge with respect to the marketing of their products (Bakos, 1991). IS includes Advanced Decision Support Systems (DSS) that are able to assist businesses in making decisions about a market without the need for investing costly resources testing that market with product. The DSS can test and even predict the way in which a particular market will respond to certain products without the need to release those products into the market. IS scientists use databases with prediction models, and in some cases Artificial Intelligence (AI), to model the healthiest market for a particular product or to create models for a particular market of interest (MaLec, 2002).

Evaluation of Current Systems
The following is a concise evaluation of Decision Support Systems and their history. Some discussion of these systems and how they are used today for the furthering of marketing decisions is also presented. When a clear understanding of the current technology has been presented, it will be possible to continue to the next section, which will delineate the future of DSS and AI.
**History of Decision Support Systems (DSS)**

The history of DSS arguably began in 1965; some of the earliest beginnings of DSS are represented in Table 1 (Power, 2003).

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Credited</th>
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</thead>
<tbody>
<tr>
<td>1965</td>
<td>DSS evolves from “the theoretical studies of organizational decision-making”</td>
<td>Peter Keen Charles Stabell</td>
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<tr>
<td>1970</td>
<td>Business journals publish articles about Management Decision Systems, strategic planning systems, and decision systems.</td>
<td>Sprague and Watson (1979)</td>
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<td>1970</td>
<td>Criteria for designing models and systems to support management decision-making are published.</td>
<td>J.D.C. Little</td>
</tr>
<tr>
<td>Mid 1970s</td>
<td>Practice and theory related issues discussed at conferences related to DSS.</td>
<td>ACM SIGBDP Conference</td>
</tr>
<tr>
<td>1970-1974</td>
<td>The first data-driven DSS was built using a Data Warehouse system.</td>
<td>Richard Klass Charles Weiss</td>
</tr>
<tr>
<td>1974</td>
<td>Management Information Systems defined as “an integrated, man/machine system for providing information to support the operations, management, and decision-making functions in an organization.”</td>
<td>Gordon Davis</td>
</tr>
<tr>
<td>1975</td>
<td>Brandaid was designed to support product, promotion, pricing, and advertising decisions.</td>
<td>J.D.C. Little</td>
</tr>
<tr>
<td>1978</td>
<td>DSS textbook provided support for systems analysis, design, implementation, evaluation, and development.</td>
<td>Peter Keen Michael S. Scott Morton</td>
</tr>
<tr>
<td>1980</td>
<td>Activities associated with the building and design of DSS started.</td>
<td>Colleges and Universities.</td>
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<tr>
<td>1981</td>
<td>DSS identified in three distinct categories:</td>
<td>Hackathorn and Keen</td>
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<tr>
<td>1981</td>
<td>- Personal DSS</td>
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<tr>
<td>1981</td>
<td>- Group DSS</td>
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<tr>
<td>1981</td>
<td>- Organizational DSS</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>Theoretical framework associated with designing knowledge-oriented DSS explained. Four components explained:</td>
<td>Robert Bonczek Clyde Holsapple Andrew Whinston</td>
</tr>
<tr>
<td>1981</td>
<td>- A language system that specifies all messages a specific DSS can accept</td>
<td></td>
</tr>
</tbody>
</table>
A presentation system for all messages a DSS can emit
A knowledge system for all knowledge a DSS has
A problem-processing system that is the “software engine” that tries to recognize and solve problems during the use of specific DSS.

Late 1980s  Model-driven spatial decision support systems (SDSS) evolved.  Armstrong, Densham, and Rushton
1990  Surveys and citation studies of models were taken to access the major applications for DSS.  Alavi and Joachimsthaler
1995  Concept of SDSS has become and firm literature reality.  Crossland, Wynne, and Perkins
1995  Web-based DSS started to evolve.  Power, Bhargava, Quek

Other milestones that helped along the way include the creation of tools like Lotus 123™ and Microsoft™ Excel™, both of which enabled people to crunch numbers and view them in a presentation manner not available before the 1980s. Tremendous hardware advancements and the reduction in computer size also contributed to DSS development. IS moved from being luxury that only very large organizations (such as the Department of Defense or I.B.M.) could afford to be an operation with a budget footprint that most businesses could handle.

**Current Technology**

One of the most prevalent technologies today is the relational database system. With the appropriate data, relational database systems are able to predict the best potential markets for prospective products. Unfortunately, the appropriate data is not always available, and new product lines are not able to take advantage of such systems. Therefore, relational systems often lack the ability to predict the best markets. More promising and relatively successful technologies are Expert Systems, Fuzzy Logic, and Artificial Neural Networks (ANN).

**Expert Systems.** Expert systems are designed to store specific market knowledge from experts and to make that knowledge available for problem solving; they can play a role in support of marketing decision making (MaLec, 2002).

- **STRATEX** – Allows for market planning in the export trade of fish and fisheries products (MaLec, 2002). Indications are that this system was actually developed by Nokia.
- **COMSTRAT** – A prototype system for strategic marketing decisions with special emphasis on competitive positioning (MaLec, 2002). This system makes use of a multi-agent view of strategic planning using group support systems (Li, 2007).
- **Woodstrat** – A Management Decision Support System (MDSS) with expert capabilities for use with action program activities at the corporate, divisional, and business unit levels in Finnish forest and wood industries (MaLec, 2002). This support system was developed for strategic management (Walden and Carlsson, 1997).
As can be seen from the various expert systems, all are specific to certain types of DSS and lack the portability and reusability desired from a true DSS.

**Fuzzy Logic.** Fuzzy logic aims at modeling the complex reasoning that plays an important role in the human ability to make rational decisions in an environment of uncertainty and imprecision. Only recently has this technology found its way into DSS (MaLec, 2002).
- AMOS – A probability-driven, customer-oriented DSS for target marketing of solo mailings (MaLec, 2002). AMOS enables the user to perform market research on how customer behavior impacts new products (AMOS, 2007).
- Fuzzy Team Decision Model – A conceptual framework for the design of new computer-based decisions systems and information systems that support decision processes for new product introduction (MaLec, 2002). One design problem that exists in this model is that the information cannot be accessed in a quantitative manner (Ullah, 2005).

**Artificial Neural Networks (ANN).** Artificial Neural Networks are distributed information-processing systems that are important in modeling fuzzy and uncertain phenomena and in forecasting non-linear systems (MaLec, 2002).
- Market Segmentation – ANN technology enables the formation of models to analyze market segments. (MaLec, 2002).
- Neural Network Model for Predicting Market Responses – A data modeling tool that is able to learn and store knowledge, used for capturing markets though powerful input and output (MaLec, 2002).
- Neural Network Model for Decision Support – Neural networks used as a tool for analyzing market share using the PIMS (Profit Impact of Market Strategy) database (MaLec, 2002). With appropriate input, users are able to analyze the market and learn from past experiences with Neural Network Modeling.

The most practical and prominent technologies in use, however, are simple database systems and spreadsheets. Databases like Microsoft Access are cheap and portable; spreadsheet designs with complex formulas are also easy to use and very portable. In some cases, people will link the two tools to create presentations that demonstrate creative market design models. These creative designs include large amounts of data to increase the accuracy of the presentation.

**The Outlook for Decision Support Systems and AI**
Future developments of DSSs will incorporate Artificial Intelligence (AI). The product will be a system unhindered by the problem of new products without comparable counterparts on the market. Systems will be able to analyze trends in the market and predict reliably product demographics. The best system will be reusable and will fit Little’s and Alter’s models in that it will be a framework that is reusable across multiple organizations / companies and it will fit the before mentioned criteria of DSS (Power, 2003). Future DSS will include four criteria: robustness, ease of control, simplicity, and completeness of relevant detail. Reusability will be accomplished through some type of software or hardware framework conforming to Alter’s model, enabling companies to take advantage of basic, generalized models common to a range of scenarios.
**Software Advancements.** Software expands the use of current technology to shape the design of future Decision Support Systems. The DSS software of the future must possess the following qualities:

1) Software must be reusable across companies and must be generic in nature.
2) Unlike the relational database systems of today, software developed in the future must not be dependent on large amounts of data entry. They must be able to predict information about products coming to market without the use of existing data.
3) Prediction models will need to be included. Businesses should be able to examine what will happen if they explore a certain market or expand a market.
4) The system must be affordable so that any size of business can take advantage of it.

What will it take to address these issues? The first step is easy: a shared framework that can be used by businesses has already been developed, but this should be enhanced. Suppose that the framework is able to learn from past experiences and apply this knowledge to future computations. Storing this information is an easy process and introduces true AI aspects to the system. The next step is to have a system that can make deductions based on known information. We want a system that can conclude that a certain event is going to happen given a certain set of facts (Rubin and Leigh, 2000). Next, the system must not require large amounts of data to make it valuable enough to use. Current systems require large stores of data to make the system accurate. Many hours are spent collecting data and putting it into the system. A system that doesn’t require exorbitant input will work out of the box. Assuming that the aforementioned learning ability is integrated into the system, it will become smarter the longer it is used. However, we can expect it to obtain a certain degree of accuracy right off the shelf.

Prediction models are the most difficult part of the system to produce; such models make up the inner workings of intelligent DSS systems. Specific models will be added as the system is used, but a few base models will predict trends in the market along with effects of new products. As an example, consider the introduction of product XYZ to the market. Prediction models may show that this product will be a huge success in this particular market, but they will also need to consider the impact of other products on the same market. There may be another product, ABC, which will see decline as a result of XYZ’s introduction to the market. If both products are owned by the same company and the decrease outweighs the increase, then there is a net loss to product XYZ’s sale. The company will know to look for another way to introduce product XYZ.

The next requirement of future software is contingency prediction. It must be flexible enough to anticipate many possible scenarios. When given a set of criteria for a new product, the system should generate as many alternative scenarios as the user can think up. This will allow companies to explore different ways of introducing new products with minimal risk of time and money. This ability would be worth millions of dollars to individual companies and create a better environment for products within the economy at large. Products that are introduced more successfully will actually squeeze the most out of everyone’s dollar.
Finally, the last criterion for our hypothetical system is that it must be affordable. No company should be excluded from the opportunity to use the system because of price. Systems today are very expensive to implement and have limited results. Only companies that are very large and able to spend large quantities of money are able to take advantage of the systems today. Additionally, the large amount of data used by the system is also typically expensive to acquire. However, the system of the future will not be dependent on this data.

**Hardware Advancements.** We are on the brink of new and faster hardware advancements limited only by the imaginations of their designers and the fundamental properties of physics. We hear almost daily of new technologies that are able to process information faster and faster. Obviously, similar computing hardware and software will make use of this increasing power. Many cars have more computing power than the very first DSS systems. Hardware growth is a double edged sword: new technology opens new avenues in DSS, but it also causes hardware to become obsolete very quickly, in months. Decision Support Systems of the future can likely be accomplished with existing hardware. Lightweight and increasingly affordable hardware will easily be able to support the software design proposed above at relatively low cost to the businesses desiring to use it.

**Conclusions and Discussions**
The history of Decision Support Systems is a short one, making it easy to trace the steps and evolution of this relatively new concept. Even small improvements to current systems will enable all companies to make better decisions about the marketing of products, which will in the long run help the economy as a whole by placing in it only the most desirable and successful products. A framework that represents the backbone of DSS will enable companies that would not normally work together on marketing concepts to coordinate their efforts. The underlying system will evolve to one that will in essence constantly learn from past experience. Some of the systems that we have mentioned in this paper indicate that we are very close to intelligent systems becoming commonplace.
References