: What should managers know about predictive analytics and model-driven decision support?

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Companies are implementing predictive analytics and quantitative models to assist managers. There remain however important knowledge gaps about how to implement analytics and especially predictive analytics and model-driven decision support. In general, analytics refers to quantitative analysis of data. Analytics may be part of a data-driven or a model-driven DSS. Predictive analytics is about using models for predicting behavior or results. Predictive analytics can help managers make choices and develop competitive actions.

Many banks use analytics and model-driven DSS when making credit and lending decisions. Trucking and delivery firms use quantitative models to generate optimal routes and fueling stop recommendations. Police Departments use predictive analytics software to better allocate resources and identify crime patterns to prevent crime and increase public safety. Managers use model-driven DSS to establish pricing for customers. Companies use Web-based systems for planning, budgeting, reporting and analysis. Factory managers and staff use optimization tools to balance manufacturing constraints while achieving more production output. A number of railroad companies use decision support systems for train dispatching and yard management.

According to Davenport, Cohen and Jacobson(2005), companies "use analytical tools to change the way they compete or to perform substantially better in the existing business model." They argue gaming firm Harrah’s "has chosen to compete on analytics for customer loyalty and service, rather than on building the mega-casinos in which its competitors have invested." Gary Loveman, Harrah's CEO is quoted, “We use database marketing and decision-science-based analytical tools to widen the gap between us
and casino operators who base their customer incentives more on intuition than
evidence.” Also, they note Amazon.com uses extensive analytics to predict successful products.

Sales forecasting software uses a moving average or econometric model; trending analytics improve fleet management profit-and-loss factors such as fuel consumption and safety performance; representational DSS use simulation models; and optimization DSS generate optimal solutions consistent with constraints and assist in scheduling and resource allocation. Model-driven DSS may assist in forecasting product demand, aid in employee scheduling, develop pro forma financial statements or assist in choosing plant or warehouse locations. Model-driven DSS are developed for various purposes using a variety of quantitative and statistical techniques.

Model-driven decision support provides managers with models and analysis capabilities to use

during the process of making a decision. The range and scope of model-driven DSS is very large. New commercial products are regularly announced, Web-based applications are widely deployed, mobile applications are increasingly common, and companies are developing their own proprietary systems. To exploit these opportunities, DSS analysts and managers need to understand analytical tools and modeling. Building some types of models requires considerable expertise. Many specialized books discuss and explain how to implement specific types of models including simulation, statistical or linear programming. Companies use both custom and off-the-shelf model-driven DSS applications.

What are analytic applications? Henry Morris, Senior Vice President for IDC's Worldwide Software and Services research groups, claims he coined the term “analytic applications” in 1997. In an article titled “Trends in Analytic Applications”, Morris argued an analytic application must meet each of the following three conditions: 1) provide process support, it structures and automates a group of tasks pertaining to the review and optimization of business operations or the discovery and development of new business; 2) have separation of function, “the application can function independently of an organization's core transactional applications, yet it can be dependent on such applications for data and might send results back to these applications”; and 3) use time-oriented, integrated data from multiple sources. Read more ....

What is analytical processing? Transforming data and summarizing it is a key task in many decision making situations. Once this task is complete, a manager analyzes and then tries to understand the information that was created. Analytical processing involves performing quantitative data transformations and mathematical and statistical summarization and generating decision relevant results. Processing refers to obtaining data and performing the analytical operations on the data. Analytical processing occurs in data and model-driven DSS and in special decision support studies. Read more ....

How do predictive analytics support decision making? Predictive analytics is a general term for using simple and complex models to support planning and operational decision making. Analysis of historical data is used to build a predictive model to support a specific decision task. The decision task may be determining who to target in a marketing campaign, what products to stock, possibility of fraud, or who the "best" customers are for a firm. Using historical data, predictor variables are identified for building quantitative or business rule models. The model makes a prediction for a decision task. Read more ....

What is a spreadsheet-based DSS? Most managers are familiar with spreadsheet packages like Microsoft Excel. If a decision support system (DSS) has been or will be implemented using a spreadsheet package it can be termed a spreadsheet-based DSS. A spreadsheet package is the enabling technology for the DSS. Both model-driven and small-scale, data-driven DSS can be

implemented using desktop, client-server or cloud-based spreadsheet applications. Spreadsheet-based DSS can be very useful, but such systems often have errors, are inadequately documented and are often inappropriate. Read more ....

Is ETL software needed to build a model-driven DSS? Extract, transform and load (ETL) tasks are part of building many types of DSS, including some model-driven DSS. BUT, the ETL software developed for creating and refreshing large data stores from transaction, enterprise resources planning (ERP) and/or operating systems is NOT needed for model-driven DSS. Model-driven DSS use complex financial, simulation, and/or optimization models to provide decision support. The needed data sets are usually small, and certainly much smaller than the 500 megabyte-10 terabyte data stores common with data-driven DSS. Read more ....

How does sensitivity analysis differ from "What If?" analysis? In the early days of decision support systems, one of the major DSS "selling points" of vendors and academics was the ability to do "What If?" analysis. In the 1970s, model-driven DSS for sales and production planning allowed a manager to change a decision variable like the number of units to produce and then immediately get a new result for an outcome variable like profit. As DSS have gotten more sophisticated and become more diverse, the use of "What If?" as a concept has broadened. We have also introduced more precise terminology from the mathematical modeling literature into our discussions like sensitivity analysis. Read more ....

Can multi-user visual simulations provide real world decision support? The computing technology for creating realistic visual simulations has improved tremendously in the past 20 years. Today, Internet-based multi-user visual simulations are creating excitement and interest in the possibilities of virtual reality for entertainment, e-business and education. The possibilities for decision support are exciting. Wade Roush, in the featured article titled "Second Earth" in Technology Review, suggests we will see an even better immersive 3-D visual environment that combines a social virtual world with tools like Google Earth to create a realistic duplicate of our earth. Read more ....

How can simulation be used for decision support? Simulation is a broad term that refers to an approach for imitating the behavior of an actual or anticipated human or physical system. The terms simulation and model, especially quantitative and behavioral models, are closely linked. From my perspective, a model shows the relationships and attributes of interest in the system under study. A quantitative or behavioral model is by design a simplified view of some of the objects in a system. A model used in a simulation can capture much detail about a specific system, but how complex the model is or should be depends upon the purpose of the simulation that will be "run" using the model. With a simulation study and when simulation provides the functionality for a DSS, multiple tests,

experiments or "runs" of the simulation are conducted, the results of each test are recorded and then the aggregate results of the tests are analyzed to try to answer specific questions. In a simulation, the decision variables in the model are the inputs that are manipulated in the tests. Read more ....

What are the rules for building a successful model-driven DSS? In a 1978 book, Andrew McCosh and Michael Scott Morton discussed some rules for building successful model-based decision support systems. The conceptual material still seems useful and relevant. Let review update and supplement McCosh and Scott Morton's rules. Read more ....

Learning to build models, develop analytics and model-driven DSS is a complex task that requires extensive preparatory work. MIS professionals who want to build models need a strong background in statistics, management science and operations research. If managers and MIS professionals want to design and build successful model-driven DSS and analytic data-driven organizations, they may need to expand their skills. If management scientists want to contribute more in building these DSS, they should cultivate a very broad understanding of decision support systems and focus less on specific quantitative and statistical tools and technologies.

Models are very important components in many DSS, but "bad" models result in "bad" decisions. Many models can be implemented quickly using prototyping. Using prototyping a new DSS can be constructed in a short time, tested, and improved in several iterations. This development approach helps us test the effectiveness of the overall design. The downside of prototyping is that a new DSS may be hard to deploy to a wide group of users. Managers and DSS analysts need to make sure the scaled down DSS will work when it is deployed more widely in a company.

On-line Analytical Processing (OLAP) is an example of using simple analytical techniques to analyze large data sets. Many model-driven DSS can be built that use a variety of organizational and external data sets. Managers should be consumers and developers of Model-Driven DSS. Widely used Model-Driven DSS need to be built systematically by a team of model specialists, MIS and network specialists and managers. Small-scale systems can be purchased or built using tools like Microsoft Excel. New Model-Driven Decision Support Systems must capture the complexity of a decision and be easily implemented and integrated into existing systems.

Model-driven DSS remain important support tools for managers, but organizations need to update existing model-based systems and develop new predictive analytics capabilities that can be implemented using Web and mobile technologies. The development environment for deploying model-driven DSS is powerful and increasingly portable. According to Forrester, "many forward-looking companies now rely on analytics as a cost-effective way to predict churn and

increase customer retention and loyalty." For example, analytics can: 1) protect revenue by predicting customer churn, 2) help set retention targets for maximum returns, 3) identify individual “at-risk” customers, 4) increase cross-sell/up-sell of products and services.

Historically, a small number of experts in statistics, management science and operations research have performed sophisticated model-driven analyses for companies. As the emphasis upon flexibility and competition increases, more and more individuals within companies will need to build and use Model-Driven DSS. Managers and DSS analysts need to be actively involved in identifying the need for and purpose of Model-Driven Decision Support Systems.

Davenport et. al (2005) concluded, "companies are beginning to employ statistical and quantitative analysis and predictive modeling as primary elements of competition." The capabilities are now more widespread and competition among firms has intensified. The demand for more and better analysis is accelerating.

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