

An Integrative Data Mining Approach for Teaching Knowledge-based Business Decision Models

Jeen-Su Lim, The University of Toledo,
John H. Heinrichs, Wayne State University, and
Lonnie J. Hudspeth, Florida Agricultural and Mechanical
University



Jeen-Su Lim

is a professor of marketing at The University of Toledo. He received his Ph.D. in marketing from Indiana University in 1987. He is the author of a book and has published over 60 articles. His work has appeared in a

variety of journals including *Journal of Marketing Research*, *Journal of Consumer Research*, *Journal of Operations Management*, *Journal of Business Research*, *Information Systems Research*, and *Management International Review*.

Dr. Lim received the 1989 People's Savings Research Award, 1999 CBA Research Award, and many grants. He has provided consulting and training to Libbey Owens Ford, Maritz, Inc., Toledo Port Authority, and Samsung America among others. He served as a department chair and research director at UT and was a co-author of the Toledo Area Manufacturing Index.



John H. Heinrichs

is on the Information Systems and Manufacturing faculty at Wayne State University in Detroit, Michigan. He is completing a Ph.D. in manufacturing management at The University of Toledo. His research interests focus

on the application of business intelligence tools to strategic business situations. John has spent 23 years in the information processing industry in roles of consulting, management, marketing, and technical support. John has presented courses on a variety of topics including leadership training, process re-engineering, and marketing analysis.

Lonnie J. Hudspeth

is the director of the Competency Center at Florida Agriculture and Mechanical in Tallahassee, Florida. He is completing a Ph.D. in manufacturing management at The University of Toledo. His research interests focus on learning and knowledge based systems. Lonnie has consulted with a variety of local and national firms on the issue of ERP system implementation.

The information age, or knowledge era, is characterized by rapidly changing customer requirements, market niches, and focused, global competitors (Nasbitt, 1982). The information age has impacted strategic business decisions of the firm by increasing the focus on business processes, supply chain management, and cross-functional relationships. Yet, it is through the application of information technology that competitive advantage is produced for the firm (Belcher & Watson, 1993; Lim, Heinrichs, & Hudspeth, 1999). This competitive advantage, however, can only be realized if insight into the dynamic, global marketplace can be achieved in a timely fashion (Day, 1994).

As firms compete in the global marketplace, they are faced with a plethora of data to be analyzed. The data are obtained from sources like the Internet, internal systems, and intelligence organizations. In 1996, 6% of the data warehouses were greater than one terabyte of data; by 1999, 30% of the data warehouses contained greater than one terabyte of data (Bransten, 1999). With the abundant amount of data, businesses are increasingly using business intelligence software tools to make sense of and gain insight into the data.

As the one sure source of competitive advantage becomes knowledge, enhancing and developing the analytical capabilities of knowledge workers to make sense of available data becomes essential (Nonaka, 1991). Yet, firms are facing a "knowledge" gap. This gap exists because of the tremendous disparity between the numbers of available, properly trained, analytical personnel and the current demand, the number of critical decisions facing firms and the expanding volume of data. This course was developed to help reduce this gap by preparing students with creative strategic thinking skills and the

application capabilities of practical business models to compete in the competitive global marketplace. It immerses them in the data-based decision-making scenarios faced by firms, provides them with the business intelligence tools utilized today, and ensures that they experience the volume and quality of information as business leaders.

The Course

The environmental changes experienced by firms in the past decade have been drastic and unpredictable. Firms are pursuing ways to be responsive to these changing environments. Complicating the situation is the advancement of information technology and its impact on the way that firms do business. The innovation of information technology makes huge amounts of customer, market, and product data available and accessible to knowledge workers. These workers are required to make the difficult transition for making strategic responses from a static perspective to a dynamic perspective.

Theoretical Premise

Traditional approaches to strategic planning have assumed a stable environment based upon the assumption that the rate of environmental change is slower than the rate at which the change can be detected, and that the environmental turbulence represents "noise" that masks fundamentally stable and unchanging relationships (Boisot, 1995). In a turbulent environment, neither assumption holds. Because turbulent environments change frequently, the decision maker's mental model can easily become misaligned with the environmental reality. Ashby's law of requisite variety states that the ability of decision makers to learn at a rate faster than the rate of environmental

change is key to preserving the firm's survival (Ashby, 1958). Unless the decision maker learns, and therefore changes his mental model accordingly, formulated strategies may unknowingly become obsolete. Mental model creation denotes sense making about changes in internal and external environments (i.e., learning). The decision tool that enhances mental model creation consists of a decision support application and cognitive aids (Singh, 1998; Vandenbosch & Higgins, 1995).

This educational offering is about creating and managing business intelligence by applying business models and decision tools to demonstrate strategic thinking. While many firms have adopted business intelligence (BI) tools in recent years, they have experienced great difficulties in making full use of their investment (Kuehn & Fleck, 1991). The software tools can provide excellent means for making responsive knowledge-based strategic decisions; knowledge workers, however, are not accustomed to using them. While they may be trained to use the BI tools, most of the training focuses on technical and mechanical aspects of manipulating the software. The intent of this course is to provide meaning, context, and a decision framework for better utilization of the BI tools. In this course, a new framework of business intelligence management is presented. It provides knowledge workers making strategic decisions with the guidelines and processes to plan, manage, and control BI tools for ever increasing customer, product, and market data.

Educational Objective

The educational objective is for the students to integrate and apply the various tools, theories, and concepts that they have learned throughout their academic careers. The course emphasizes the development of strategic thinking via the hands-on application of business intelligence and decision-making tools. The situations and exercises faced by the students are developed from real-world problems to ensure that students are aware of the various situations they could encounter.

Innovative Features

Several concepts and techniques set this course apart from other courses utilizing computers and case-type information.

They include the use of leading-edge BI tools coupled with multidimensional analytic databases and the presentation of internal data with external competitive data. Additionally, the capturing and storing of customer satisfaction information, brand level information, application and use of statistical techniques, and focus on having the students develop business insight and acumen, position this academic offering as a truly integrative course.

We have taken a new innovative approach to case analysis. In typical case analyses, all necessary processed information for making decisions is presented in narrative, table, or figure format. The reality is that knowledge workers are rarely given necessary and critical information for decision making in a report form. Consequently, the traditional case analysis method would provide meaningful exercises in a static environment. The turbulent business environment of the 21st century requires a new pedagogical alternative that reflects a requirement of flexibility and timely response. We utilize a scenario and data-based cases where a multidimensional database is provided for analysis and insight generation purposes with DecisionWeb™ and statistical tools.

A unique aspect of the course is that the student is positioned in the midst of ongoing competitive pressures and business decision problems in an existing firm. Each team is expected to capitalize on individual skills and knowledge to produce different business insights and actionable plans. As such, each team can arrive at entirely different strategies and business insights. During the facilitated debriefing of the exercises and cases, additional insights can be obtained.

Level of Students

The students who have taken this course are seniors preparing to graduate with a bachelor's degree, graduate students pursuing a Masters of Business Administration, and graduate students in other colleges who are working toward a minor in a business-related field. The graduate and undergraduate version of this course has been taught to approximately 225 students over four semesters.

Course Content

The first part of the course deals with strategic decision making in an information age. Effective strategic decisions begin with a clear understanding of the nature of the business environment. Increased global competition, faster product development cycles, shorter product life cycles, the Internet, and e-Commerce are some of the contributing factors to the changing business environment. This environment represents volatility and risk for the business. In managing this risk, knowledge-based strategic decision-making capabilities become the only sustainable core competence of firms. The nature of the changes and the need for developing business intelligence capabilities in an information age are discussed (see Figure 1).

The second part of the course deals with BI tools and organizational processes. To cope with the volatile and risky business environment, firms need a new way of thinking. Given the increased pressures of the global environment, it is increasingly necessary for a firm to establish a system whereby managers can make knowledge-based decisions. The manager's mental model provides a basis for designing the

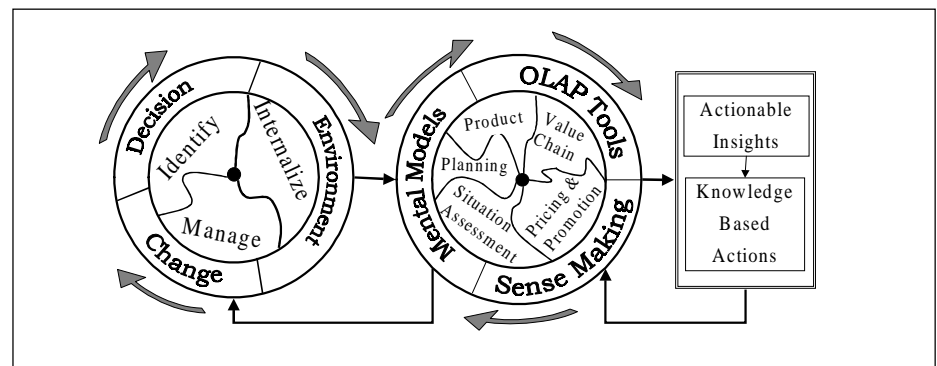


Figure 1: Course topics.

Decision Area	Decision Model Examples
Strategic Planning	BCG; Customer Value Map
Situation Assessment	Forecasting; Market Analysis
Product Performance	Brand Equity; PowerGrid
Value Chain Management	Strategic Profit Model; Contribution Model
Pricing and Promotion	Price Elasticity; Advertising Effect; Break-even Model

Table 1: Decision model examples.

Topic Area	Pre-Test Score	Post-Test Score	Significance
Analysis Techniques	3.59	4.90	.000
Business Intelligence Tools	4.36	6.08	.000
Business Models	4.50	5.71	.000
Strategic Thinking	4.98	5.92	.000

Table 2: Skill assessment scores.

Question Area	Mean Score	To a Very Great Extent - 5	To a Great Extent - 4
Critical Questioning	4.50	51.9%	40.7%
Overall Course Rating	4.44	53.6%	33.3%
Proficiency in Usage of Business Intelligence Tools	4.54	55.6%	37.0%
Related Material to Business	4.67	70.4%	25.9%
Understanding Business Models/Concepts	4.54	51.9%	40.7%

Table 3: Course evaluation rating scores.

strategic decision variables and performance metrics. The relationship between these decision variables and performance metrics are assessed based on theories and business practices. An iterative process of utilizing BI tools in making strategic decisions is presented. Also covered is a review of BI tools, technical aspects of BI tool implementation, and technical training of a BI software tool.

The third part of the course focuses on giving life to the business intelligence framework and tools in a strategic marketing context. Various decision areas (see Table 1) are identified: strategic planning, situation assessment, product performance, value chain management, and pricing and promotion strategy. In each of the decision contexts, theoretical models that can provide managerial insights are described. These theoretical models are tested

using one of the leading decision support tools, Comshare DecisionWeb™. Excel™ and SPSS™ are also utilized to perform additional statistical analysis. These tools are used in a complementary fashion to provide better insight and meaningful knowledge. To illustrate the business intelligence process through strategic analysis examples, databases were created from competitive market data, census data, Compustat database, and other external sources. Hands-on application examples are presented using a medium-sized company in the cosmetics and toiletries industry.

In summary, this course is about how to create powerful and elegant solutions that set the standard for business intelligence management in the 21st century. It is guided by a gap between the development of the BI tools and the effective use of them

in making strategic business decisions. We believe this course can build an important bridge between the technical development of BI tools and the effective utilization of these tools in strategic business decisions.

Implementation Results

Multiple methods were used to assess the student's acquisition of the requisite skills and abilities. These methods include a pre-test and post-test of perceived skills by the student, a pre-test and post-test of various business knowledge-based concepts, a course evaluation, BI tool assignments called "Bootcamp" exercises, and an entrance, mid-term, and final scenario exam. The students also presented their developed insights to a posed case situation. The case situation was assessed utilizing a modified scale based on the Malcolm Baldrige National Quality Award assessment criteria. The pre-test and post-test of perceived skills consisted of 64 multiple choice questions covering business tools, business models and concepts, questioning skills and analysis tools. The questions focused on the student's increase in business model application skills, business intelligence abilities, and strategic questioning and thinking skills. The test scores are measured on a 7-point Likert scale. The results of the perceived skill pre-test and post-test are shown in Table 2. The students showed significant increases in perceived skill in all key areas supporting the achievement of the educational objectives.

The students provided a course evaluation at the end of the semester. The evaluation consisted of 25 questions. It provided the students an opportunity to share their opinions via written comments. The course evaluation scores are measured on a 5-point Likert scale. The mean for the key questions was above a 4.00. The key questions relating to the objectives of the course are listed in Table 3. The written comments provide insight into the rationale for the numeric ratings. A representative sample of the written comments from the summer semester is provided in Table 4.

Implications

Course Perspective

Rapid change, incomplete but voluminous data, and complex, turbulent competitive dynamics characterize the current environment. The ability to quickly assimilate and

Sample Comments from the Course Evaluation

"The fact that we could take the concepts we learned and present them to others ... demonstrating insightful ideas. This helped my understanding of (key concepts) and helped my presentation skills."

"... the emphasis of no correct / incorrect answer ..."

"This is the best course I've taken so far in the MBA program!"

"The real world application of the models and the (business intelligence) software."

"Learning to develop critical questioning and using business models for (strategic) decisions."

"Course material wholly integrated with analysis software."

"It definitely made you think. It combined all the business concepts learned from past years. *Critical thinking* was a must."

"... the usefulness of this course is extremely important. ... (Business classes) should relate to the real world. This is the only class I've taken where I feel that I learned something."

Table 4: Course written comments.

interpret data and information, generate knowledge, and formulate that knowledge into actionable insights will separate the winners from the losers. The fierce and harsh realities of competitiveness do not permit firms to "learn these competencies as they go." Such abilities must be cultivated through training, coaching, and experience.

Leading edge firms are using BI tools with multidimensional databases to better manage the voluminous and complex data. Such firms realize that knowledge management is the key to maintaining any possibility of competitive advantage. Although BI tools are available to firms, there is still a huge "knowledge gap" in the managerial and professional competence utilizing these tools. In other words, the "know-what," "know-how," and "know-why" of BI tool use is in very short supply (Deschamps & Nayak, 1995).

Academic Adoption

To facilitate the diffusion of the innovative learning paradigm presented earlier, the software tools were continually updated. After the two previous versions of BI tools, web-based BI tools are now implemented with a server designated for this course. With this web-based implementation, the adoption of this learning approach is possible for any business program with Internet access for students. Students can access the software tools and databases for

class exercises through the Internet. Strategic guided analysis (Lim, Heinrichs, & Hudspeth, 1999) can enable students to experience web-based BI tools and data-based case analysis. The pedagogical approach will be appropriate for senior undergraduate and MBA-level marketing and management strategy or capstone courses. For possible adoption, please e-mail your inquiry to jljm@utnet.utoledo.edu.

Executive Training

Preliminary presentations have shown receptivity to new approaches to managerial education. The ability to customize the multidimensional database with the firm's data enhances the learning experience. The instruments used have been validated and curriculum credibility has been established via academic rigor.

The executive training course provides managers with an opportunity to learn the skill of using BI software tools and apply business models. It provides them with a setting where their competence at knowledge generation and knowledge management is cultivated. Managers are taught to utilize the tools to analyze and illustrate business data. Through the utilization of BI tools and decision models, managers are coached in the art and skill of critical questioning and strategic thinking as a means of insight development and knowledge generation. The abilities to make sense of the data and charts, and then to ask the

relevant follow-up questions, given their interpretations, are not taken for granted. Instead, these abilities are understood to be valuable competencies. Our executive training will help managers develop these competencies so that they can become effective *strategic thinkers* and *knowledge managers*.

References

- Ashby, R. W. (1958). Requisite variety and its implications for the control of systems. *Cybernetica*, 2, 83-99.
- Boisot, M. (1995). Preparing for turbulence. In B. Garratt (Ed.), *Developing strategic thought*. London: McGraw Hill, 29-45.
- Belcher, L. W., & Watson, H. J. (1993). Assessing the value of Conoco's EIS. *MIS Quarterly*, 17(3), 239-253.
- Bransten, L. (June 21, 1999). Looking for patterns. *The Wall Street Journal Reports*, Dow Jones & Company, R16.
- Day, G. (1994). The capabilities of market-driven organizations. *Journal of Marketing*, 58, 37-52.
- Deschamps, J., & Nayak, P. (1995). Fomenting a customer obsession. *National Productivity Review*, 89-122.
- Kuehn, R., & Fleck, R. A., Jr. (1991). Implementing and EIS in a large insurance corporation. *Journal of Systems Management*, January, 6-17.
- Lim, J., Heinrichs, J., & Hudspeth, L. (1999). Strategic marketing analysis: Business intelligence tools for knowledge based actions. Needham Heights, MA: Pearson Custom Publishing.
- Nasbitt, J. (1982). *Megatrends*. New York: Warner Books.
- Nonaka, I. (1991). The knowledge-creating company. *Harvard Business Review*, 96-104.
- Singh, D. T. (1998). Incorporating cognitive aids into DSS. *Decision Support Systems*, 24, 145-163.
- Vandenbosch, B., & Higgins, C. A. (1995). Executive support systems and learning: A model and empirical test. *Journal of Management Information Systems*, 12(2), 99-130. ■