Many people want examples of DSS and students are often interested in "building" DSS. Finding small-scale yet interesting DSS projects can however be difficult. Building and discussing cost estimation DSS is one possibility. A cost estimation DSS is a software application that helps a person estimate cost elements and finalize a bid for a prospective customer. "Cost estimation" refers to the purpose of the Decision Support System and does not constrain how the system is implemented. The generic task is subtle and semi-structured and it can be approached in many ways. A cost estimation DSS may be a model-driven or a data-driven DSS. Data-driven DSS help "add up" cost elements from a database and usually provide limited analytics. Cost estimation DSS are frequently model-driven and spreadsheet-based, but other types of DSS are developed and marketed for assisting in this task (see TechComm Associates, 2003). Successfully estimating costs is important to the survival and profitability of many firms in many different industries.

According to the U.S. Department of Labor (BLS, 2002), "cost estimators develop the cost information that business owners or managers need to make a bid for a contract or to determine if a proposed new product will be profitable". In some businesses, cost estimates are prepared on the back of an envelope or on a simple "bid" sheet. As the complexity of the estimating task increases computerized decision support becomes increasingly important. There were more than 200,000 cost estimators in the United States in 2000, about 50 percent worked in the construction industry and 20 percent in manufacturing industries. Currently, most estimators DO NOT use computerized decision support.

So what is involved in preparing a cost estimate? What is the decision process? A general description suggests the importance of the task. The BLS handbook notes "The methods of and motivations for estimating costs can vary greatly, depending on the industry. On a construction project, for example, the estimating process begins with the decision to submit a bid. After reviewing various preliminary drawings and specifications, the estimator visits the site of the proposed project. The estimator needs to gather information on access to the site and availability of electricity, water, and other services, as well as on surface topography and drainage ... After the site visit is completed, the estimator determines the quantity of materials and labor the firm will need to furnish. This process, called the quantity survey or "takeoff," involves completing standard estimating forms, filling in dimensions, number of units, and other information. A cost estimator working for a general contractor, for example, will estimate the costs of all items the contractor must provide. Although subcontractors will estimate their costs as part of their own bidding process, the general contractor's cost estimator often analyzes bids made by subcontractors as well. Also during the takeoff process, the estimator must make decisions concerning equipment needs, sequence of operations, and crew size. Allowances for the waste of materials, inclement weather, shipping delays, and other factors that may increase costs also must be incorporated in the estimate. On completion of the quantity surveys, the estimator prepares a total project-cost summary, including the costs of labor, equipment, materials, subcontracts, overhead, taxes, insurance, markup, and any other costs that may affect the project. The chief estimator then prepares the bid proposal for submission to the owner."

The BLS report notes "In manufacturing and other firms, cost estimators usually are assigned to the engineering, cost, or pricing departments. The estimators' goal in manufacturing is to accurately estimate the costs associated with making products."

For the past 2 years, I have required students in my DSS/MIS course to work in teams to analyze, design and then build a spreadsheet-based DSS for cost estimation. I started requiring this project

because there were so many possibilities and yet students could use a readily available spreadsheet package, like Excel, to build a DSS. The project provides many opportunities for student creativity and initiative; teams work on an important, non-trivial task; students can apply Excel skills they have learned on a small-scale "real" project. Also, students go through the steps in analysis and development and they create and submit deliverables. I encourage teams to follow a decision-oriented design approach and begin by studying a specific cost estimating process in a specific business.

Teams pick an estimating situation and then research, plan, and develop a specific DSS for that situation. The team develops a model-driven DSS for estimating the cost of an event/project and preparing a competitive bid to submit to the person requesting a proposal. The specific DSS supports a person working as a cost estimator or bid specialist or a similar job title. The specific model-driven DSS that is developed should help an estimator input data, apply a detailed quantitative estimating model, conduct sensitivity and "what if" analyses, and prepare a formal bid proposal. Project teams submit 4 deliverables during the semester. Deliverable 1 is a project analysis, specification and research summary report; Deliverable 2 is a model specification and project plan; Deliverable 3 is the completed Spreadsheet-based DSS; and Deliverable 4 is the documentation.

An algebraic model provides the decision support functionality, but the model-driven DSS application needs to facilitate elicitation of values and estimates and then help the estimator complete "what if?" and sensitivity analysis. Some teams break the estimating task into phases or separable divisions. Some teams try to identify standard cost data to compare to estimates. Occasionally a team will propose calculating a bid from an established "price" sheet. This approach neglects all of the cost issues and provides no information to the decision maker about the profitability of a job or project. IMHO this application is NOT a decision support system even though a spreadsheet is used to help with calculations. Teams receive negative feedback about this proposed application. Understanding costs in an estimating situation is usually a major challenge and teams need to face this challenge to build a successful DSS.

Occasionally development teams try to help an estimator answer the question "Should we bid?" in addition to "How much should we bid?" Rarely do teams grapple with the complexity of bidding in the context of a portfolio of bids. In general, the model-driven DSS focuses on a "fixed" price or a "not to exceed" bid situation. Teams need to determine how much detail should be in the cost estimate and how overhead should be allocated. A major issue facing estimators is assessing profitability and keeping the bid amount competitive. Also developers need to determine if it is more appropriate to provide for a profit markup or a markdown. Should profit be an across-the-board percentage or should the DSS provide for selective adjustments to cost elements? Markup pricing usually covers overhead and profit contribution so the issue becomes how much markup? In some situations, labor time estimates are especially difficult to forecast. Perhaps both labor productivity and labor costs need to be considered in an estimate. Also, some teams neglect "what if?" analysis and sensitivity analysis. In a model-driven DSS this capability is important. Also, developers need to determine if common size percentages of cost categories will help the estimator. Is it helpful to show the estimator a bar chart of amounts for major cost elements? Each cost estimating process has its own demands, nuances and idiosyncrasies. The development team needs to make design decisions that accommodate the specific estimator and estimating situation.

Teams are encouraged to look for projects in three industry situations: construction cost estimating, convention and meeting cost estimating, and software development cost estimating. Please note! It

is important that the project involve sufficient complexity to justify building and using a spreadsheet-based DSS in the estimating situation. Some representative cost estimation DSS project titles from the past 2 years include:

"Cost estimation for a major event on a college campus"

"Light industrial construction cost estimating"

"Meetings and banquets cost estimating"

"New home construction estimating"

"Prepare attestation bids for a medium-sized accounting firm"

"Prepare bids for a hotel resort convention center"

"Provide cost estimates for weddings"

"Software project cost estimating"

"Vector mapping cost estimating"

The Occupational Outlook Handbook (BLS, 2002) reports that "Computers play an integral role in cost estimation because estimating often involves complex mathematical calculations and requires advanced mathematical techniques. For example, to undertake a parametric analysis (a process used to estimate project costs on a per unit basis, subject to the specific requirements of a project), cost estimators use a computer database containing information on costs and conditions of many other similar projects. Although computers cannot be used for the entire estimating process, they can relieve estimators of much of the drudgery associated with routine, repetitive, and time-consuming calculations. Computers also are used to produce all of the necessary documentation with the help of word-processing and spreadsheet software, leaving estimators more time to study and analyze projects."

Cost estimation DSS can help cost estimators prepare bids faster and more accurately. A sophisticated DSS can help insure that when a company wins a bid that it will be able to profitably complete the event/project.

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