Development of a Decision Support System Based on ABC for Costing and Pricing Decisions, and its Conversion to a Web-based DSS

*Charles H. Cho**
*Emilio Boulianne***

Abstract

In the rapidly growing industry of semiconductor, management is constantly faced with difficult decisions. Activities such as sawing, cleaning, stocking and inspecting die (also called chips) involve complex processes. The costing and pricing of die affect the bidding strategies and company profitability. This paper presents theoretical frameworks to discuss how the decision-making process has evolved from heuristics (i.e., decisions made manually based on biased estimates) to computer-based information systems. It offers a case study of the design and implementation of a decision support system (DSS) integrating activity-based costing (ABC) in a large U.S. supplier of semiconductor die. The advantages of this system are explored when a solid accounting model is used to store, retrieve and analyze data, especially with the implementation of a Web-based component. The system is user-friendly and provides powerful features that help top management make more effective costing and pricing decisions. Users are satisfied with the DSS as it contributes to an increase in firm profitability.

Keywords

Decision Support System (DSS); Information Systems Design and Implementation; Activity-Based Costing (ABC); Web-Based Model; IS Success; Semiconductor Industry

* University of Central Florida
** Concordia University

Introduction

The primary stakeholders in the high-tech oriented semiconductor chip industry are the manufacturers, die suppliers/processors and customers. Large chip manufacturers sell high quantities of wafers to die processing companies which saw, inspect, test, clean and stock them in order to ensure a high quality production of die. *Die* is another way to describe a chip, and a *wafer* is a small thin circular slice of semiconducting material, such as pure silicon, on which an integrated circuit can be formed. Therefore, a wafer can carry a very large number of small die because it is designed to allow the formation of such integrated circuits. Processed die are then sold to customers, which are large electronics manufacturing companies that operate worldwide. This process is critical to these customers because of their strict quality requirements and criteria. The quality of their end products heavily depends on the quality of the die that will be used in the production cycle.

In the past, the cost of processing wafers was less critical for semiconductor die suppliers. The relatively small number of such companies present in the marketplace at that time caused a low competition effect to take place. There seemed to be no constraint or competitive limit on how much (in dollars) to quote for the selling price of one piece of die.

The following statement from management reflects the business environment at that time:

> *"Decisions about costing and pricing die were literally made on a piece of paper.....heuristics were used and the system was not computerized.....there was*

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no accurate cost analysis[1].”

Nowadays, global competition has intensified due to the industry boost. Manufacturers understand that product quality will make the difference and the number of wafer processing companies is growing to become highly competitive. Losing a few substantial bids from large customers can be detrimental for them. This will lead to a decline in profits and a loss of market share. Accordingly, the key to an effective bidding strategy, i.e., quoting the right price, resides in the ability to accurately estimate the unit cost of processed die. The following statement from management reflects this change in the business environment:

“Although decisions based on heuristics are prone to fail, the company was profitable, making so much money that they could offset some losses. But high competition drove profits to decline sharply and problems began.”

This paper presents a descriptive case study of a large U.S. supplier of semiconductor die (hereafter, the “Company”). Our purpose is twofold. First, to explain how the decision-making process has evolved from heuristics to the use of a decision support system (DSS) through theoretical frameworks; second, to provide a thorough description of the design and implementation of a DSS allowing the Company to determine the cost of processing of die using activity-based costing (ABC), its consequences, implications and opportunities. Research contributions are as follows. First, demonstrate the benefits of a computer-based information system to make accurate and effective costing and pricing decisions in a competitive environment. Second, provide a real-life, detailed experience of a successful DSS design and implementation based on ABC. This is important as many firms have not gained the promised benefits of the ABC concept (Chenhall, 2004). Finally, learn more on the semiconductor die processing industry – an important, competitive, and evolving sector of the new economy.
The remainder of paper is organized as follows. We first provide a synopsis of the current semiconductor chip industry and its business processes. Then, we review decision-making theoretical frameworks in the DSS literature, linking them to the Company’s situation. In the two sections thereafter, we explain and report on the utilization of activity-based costing as part of the DSS and the research method. Lastly, we conclude with a discussion about managerial impact, technological advancement and future research avenues.

The Semiconductor Industry and its Business Processes

The semiconductor chip industry is characterized by rapid and frequent technological changes as well as the introduction of new technology, leading to more complex and integrated products. These features result in a cyclical environment with short product life, price erosion and high sensitivity to the overall business cycle (National Semiconductor, 2003). However, there is no doubt that the industry has been positively able to overcome these potential barriers and sustain its position globally. According to the Semiconductor Industry Association (SIA), worldwide chip sales for 2002 increased as the sales trends in the four major geographic regions of the world were reported as follows: +0.56% in the Americas, +6.2% in Europe, +0.8% in Japan alone and +1.0 % in Asia-Pacific (which includes all nations of the region except Japan). In addition, currently announced plans and projects under construction will add over 20% to the industry’s current capacity. Such a positive prediction is mainly due to “a recovery in information technology spending, a fast-paced wireless market, and the emergence of new growth sectors” (Bolaji, 2003).

Wafer processing operations include: (1) sawing, which is separating the wafer into individual pieces of die; (2) storage, which

[1] The statements from management come from conversations and semi-structured interviews between the DSS designer and the first researcher. The DSS designer, as a member of the project development team, met numerous times with management.

involves loading the die onto a carrier for protection against movement; and (3) inspection for any defects. Wafer thickness, width of the saw streets, metal composition and die size must be carefully considered when determining the relevant sawing parameters. Wafers are designed to hold as many die as possible because the cost of producing a wafer is fixed. As a result, the more die can properly fit onto a wafer, the lower will the production cost be. After being sawn, die are placed into a carrier, commonly referred as the "waffle pack" before delivery[2]. The most critical step in wafer processing is the inspection. Inspection may be performed manually by an operator using a microscope, or it can be completed by sophisticated equipment using vision recognition software. The goal is to look for any defects that would either prevent a proper long-term functioning of the device.

The Company's emphasis on the inspection process is evidenced by the initial eighty hours of training and the re-certification process on a six-month cycle provided by the Company to their highly qualified staff of inspectors. All of these activities are conducted in a Class 10000 clean building, at Class 100 workstations[3]. The Company is currently capable of holding over six million die of thousands of geometries in their stockroom. This allows for stocking specific die to meet the demands of certain customers. Despite the apparent complex features of the industry, the overall situation is a positive outlook for the industry.

Decision-Making Frameworks

The unit cost per die generated from a processed wafer is a major determinant of the competitive position of the Company. Die are produced in high quantities (i.e., millions) because there is a very large number of die on each wafer and customers purchase bulks of these wafers. Therefore, the price per each piece of die becomes extremely sensitive to the total amount of the bid. It is also critical for the Company to quote an adequate unit price per die so that it does not lose the bid (by quoting too high) or does not hinder their profitability (by quoting too low). Both phenomena were occurring at the Company. Bids were lost, profitability decreased and the company started experiencing an overall loss of market share. Management decided to address the issue and felt urgency to review their bidding strategy.

Conceptually, the most accurate way to determine the unity selling price per die is to compute its unit cost. The following questions then emerge: How did management determine their cost to process die? What were the parameters involved in the process of determining the cost in dollars to produce and place a piece of die ready to be sold? Based on discussion with management, the answer was the use of *heuristics*. The initial cost amounts from previous reports or a result of partial computations were usually given as a starting reference point and biased estimates and adjustments were made to determine the cost (for a discussion on this type of process, see Hogarth, 1987).

Clearly, this type of decision-making process requires tools other than heuristics. Different frameworks have been developed to date; however, Gorry and Scott Morton (1971) were among the first to introduce a framework for management information systems (MIS) to help organizations effectively plan and allocate resources to such systems tasks. This framework essentially lays foundation for DSS. It focuses on managerial decision making activities rather than information systems only and hereby gives another perspective on how decisions are (or should be) made in organizations. According to them, "an understanding of managerial activity is a prerequisite for effective systems design and implementation" (1971, p. 56). Keen and Scott Morton (1978) define DSS as a computer-based system personally used by

[2] Gel Pak® is another type of carrier, which holds the die by surface tension, thus allowing no die motion.

[3] Clean rooms are classified as Class 1, Class 10, Class 100, Class 1000, Class 10000, & Class 100000 according to standard FED STD 209E. The numbers represent the number of particles present in one cubic foot of air. As a reference point, a home has usually over 100,000 particles per cubic foot. In addition, these rooms are tightly controlled for humidity and temperature.

managers and staff on an ongoing basis in direct support of managerial activities – that is, decisions. They also argue that the "key point for a DSS is to support or enhance the manager's decision making ability," and DSS "shifts attention from the level of operations […] toward the issues of managerial problem solving" (1978, p. 57). As part of their new paradigm for computer-based DSS, Beynon et al. (2002) argue that the type of DSS model application that improved the quality of human-computer interaction is the spreadsheet-type. It is, however, interesting to note that such package tools "did not appear until direct access storage devices made interactive operating systems technically and economically viable." (Courtney, 2001).

In light of declining profits and loss of market share, it would be rational for the Company to evolve from heuristics to a DSS. A successful DSS should be designed to be easy to understand, provide relevant information, and be flexible enough to adapt to organizational changes (Sprague and Watson, 1986). Although many organizations are reluctant to allocate resources towards the design and implementation of expensive custom-made solutions, the Company took the initiative to implement a DSS to support managers' decisions on the determination of the quoted unit price per die. As the nature of management decision heavily relates to some cost accounting analysis issues, it would therefore be appropriate to classify their DSS as an accounting model (Sauter, 1997). As we will later discuss in the paper, the DSS is implemented in Microsoft Excel due to its inherent functionality, user friendliness, user acceptance, and availability. The next section describes how ABC has become the backbone of the Company's DSS.

A Decision Support System based on Activity-Based Costing

According to Bainbridge (1993), the main issues faced by an organization are cash flow, stewardship of assets, investment decisions, and product pricing. According to some of the prominent scholars in management accounting research, important decisions about pricing are too often made based on distorted cost information. Cooper and Kaplan (1988) made it clear that increased global competition and new product technologies have made accurate cost information critical to competitive success: "bad information on product costs leads to bad competitive strategy" and "most companies detect the problem only *after* their competitiveness and profitability have deteriorated." These statements are illustrated by the Company's strategic position where profitability and market share were declining. Pricing is a function of many variables such as cost (the most important), elasticity, competitors and economic conditions. As a result, inaccurate pricing mainly comes from *undercosting* or *overcosting* a job.

The theory behind activity-based-costing or ABC is that *all* activities to support the production and delivery of a company's goods must be taken into account in the product costing process (Cooper and Kaplan, 1988). Kaplan and Atkinson (1998) define ABC as follows:

> *"Activity-based costing developed to provide more accurate ways of assigning the costs of indirect and support resources to activities, business processes, products, services, and customers…..The goal is to measure and then price out all the resources used for activities that support the production and delivery of products…to customers" (Kaplan and Atkinson 1998, p. 97).*

ABC systems focus on organizing costs into activity cost pools rather than by department to determine the cost of resources used in organizational processes to produce outputs (Krumwiede and Roth, 1997; Kaplan and Atkinson, 1998). The primary reason the Company implemented ABC was to use information generated by the system to recost and reprice their products. The DSS model's output is the unit price per die that should be quoted during the bidding process. It is computed based on the cost per die generated by the ABC system embedded in the DSS.

Krumwiede and Roth (1997) propose several steps for a successful implementation process of an ABC system as part of an information technology innovation, which include analysis and activity-based management (ABM) stages. At the analysis stage, the project development team studies the linkages between activities and costs, concentrates on identifying cost drivers and captures all relevant data in order to design the ABC system; at the ABM stage, the system is implemented, used and operationalised by management to improve profits. Its focus expands beyond mere product costing to planning, execution and measurement of basic activities.

Research Method

Management decision to implement a decision support system led the Company to hire a system designer, expert in the fields of both information systems and ABC. The total cost of design, development and implementation of the DSS with the ABC exercise (which largely consists of the systems designer's working time) is estimated to be about $100,000 (U.S. dollars). This amount also includes wages paid to two assistants hired by the Company (they were, however, recommended and supervised by the system designer) working on site full-time and part-time, respectively. While the design, development and implementation of the overall system were primarily executed by the system designer, data collection was performed by the two on-site assistants, under the designer's guidance and supervision.

In ABC, activities are defined as "groups of related processes or procedures that together meet a particular work need for the organization" (Hicks, 1992). Activity analysis is the identification and description of activities in an organization and it involves determining what activities are done, how many people perform the activities, how much time they spend performing those activities and what resources are required to perform such activities. The activities related to the processing of die from wafers were identified through interviews, reviews of physical records, and questionnaires. Activity costs were then traced to the product by matching a cost driver for each activity, as suggested by Miller (1996). Cost drivers can be transaction, duration or intensity drivers. Transaction drivers count how often an activity is performed, whereas duration drivers measure the amount of time required to perform an activity. Intensity drivers directly charge for resources used each time an activity is performed (Kaplan and Atkinson, 1998). The activity cost drivers selected for the ABC system were mainly transaction drivers (number of die and wafers) and duration drivers (hours and minutes spent in each activity). Data gathering, a major part of the analysis stage, is a lengthy and tedious process. Therefore, according to Hicks (1992), data gathering should focus on accuracy to get the ABC model cost-effective.

DSS Design and Data Collection

The design began with numerous meetings and interviews to learn about the needs of the decision makers. During this initial step, discussions were heavily geared towards the identification and description of all the activities involved in the processing of die. For example, input data such as customer type needed to be defined. Type A customer may be a preferred customer while type B could be a new customer. Relationships and formulas had to be established to take into account the number of shipments and receipts. This would affect pricing since for instance; recurring shipments would cost more than a one-time delivery. On another hand, historical data were used to track trends and perform analysis. The Daily Production Report in Appendix One is an example of data collection form that shows how activities were categorized by processing steps. The form was designed based on data needs identified through interviews with specific department managers. Necessary information consisted of the time spent to perform a certain step related to a specific job, the job number and the quantity of die and wafers processed through that. Interviews with managers also provided the different possible steps, i.e. activities, for a job. This step is crucial in order to collect the proper data effectively. The form went through several iterations before management and the designer settled on the final design. The lengthy, tedious process of data collection for the activities performed in the processing of die then took place. Forms were subsequently given to the employees performing daily activities during the data collection period. They were requested to fill out all the information and turn in the forms along with their timesheets. Data were then entered and compiled in Excel to generate regressions (see discussion in the next sub-section). Because most of the data gathering involved manual entry of handwritten data, clerical errors were inherently made. Nonetheless, the system designer and the on-site assistants were able to detect such mistakes and remedy the problems.

Of interest are also the behavioural aspects of data collection and organizational tension associated with the implementation of a new system. At first, despite numerous explanations from the designer and the on-site assistants, some organizational tension was created due to a misunderstanding from employees about the purpose of such data collection (i.e., filling the forms). Employees believed that they were being monitored for efficiency and performance evaluation; as a result, they provided invalid time data on the forms, which caused some unproductive time during this process. However, after some efforts of explanation and reassurance that these data would only be used for the purpose of developing a new costing system, the situation improved, data collection became much more feasible and the designer was able to complete the DSS implementation project. Conversely, management was very cooperative from the beginning to make this project successful. This phenomenon (differences between employees management when a new system is implemented) appears to be somewhat an expected organizational behaviour. It is also interesting to note that the Company's IT employees did not possess a strong knowledge in costing issues. However, it was primarily composed of retired military personnel specialized in technologies and systems, which helped the implementation process. Overall, because the primary objective of the DSS was to fulfil information needs to increase efficiency and become competitive, management and employees' participation, cooperation and involvement were deemed to be present and acceptable.

DSS Development and Implementation

A DSS should be simple, friendly, adaptive, and easy to communicate with. In the Company's system, functionality of the user interface was a key factor of its implementation success. Microsoft Visual Basic for Applications (VBA) programming language is utilized to manipulate Microsoft Excel objects. When creating custom applications, "it is the glue that binds Excel objects together" (Wells and Harshbarger, 1997). As a result, Excel and its related VBA were selected in the design of the DSS because of their inherent functionality and user acceptance and they could provide the necessary tools to create a user friendly DSS. Successful implementation of a DSS depends heavily on users' acceptance (Leonard-Barton, 1988). In addition, the use of Excel and VBA allowed management to eliminate additional software costs as all necessary programming functions were feasible from the package.

Regression analysis is a modelling technique for analysing the relationship between a continuous (real-valued) dependent variable Y and one or more independent variables $X_1, X_2, \ldots, X_k$. "The goal […] is to identify a function that we can predict what value the dependent variable will assume given specific values for the independent variables" (Ragsdale 2001, p. 407). The Company's DSS includes thousands of regression models performed on cost driver data. These cost drivers are related to activities performed.

Figure One: Example of Regression Analysis

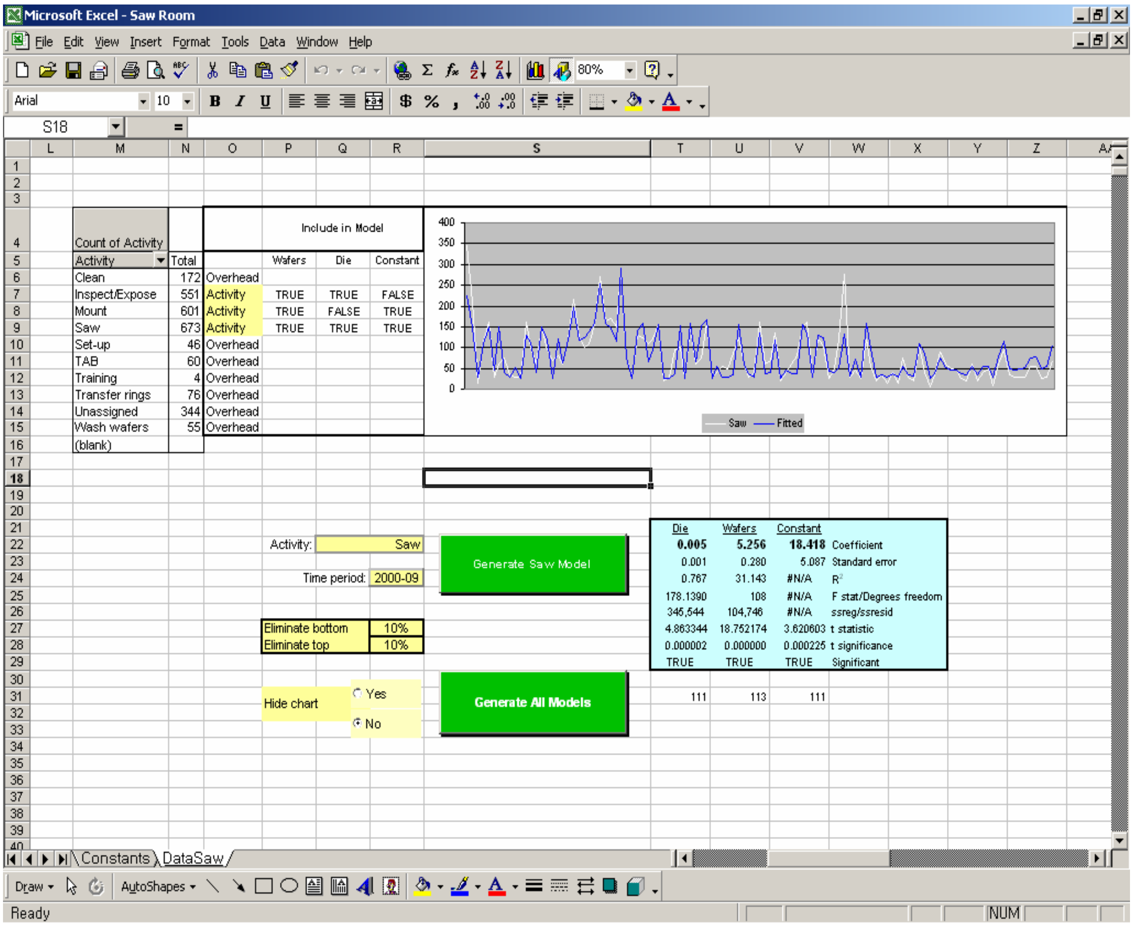


Figure One shows an example of one of such regressions performed. Relevant data were already captured in an analysable format and the built-in Excel Regression function allowed the DSS designer to use it as an effective means to measure relationships. Thus, regression analysis proved to be beneficial as it offered an efficient statistical tool to correlate cost driver activities of wafer processing with their respective measurement of their time and cost.

Data and variables obtained through the regression models are stored in a Microsoft Sequel Server database. They will constitute the basis of the system when costing and pricing a die. Other information related to customers, sales representatives and activities are also stored in this database. The VBA code then manipulates the data in order to present them in user-friendly form through the user interface, "the method by which the user interacts with the application – clicking buttons, using menus, pressing keys, accessing toolbars, and so on" (Walkenbach 2000, p. 869). VBA is based on the understanding and manipulation of object models for its host application (e.g., Microsoft Excel). Consequently, a solid user interface with password protection was developed with VBA.

Features such as custom dialog boxes, ActiveX controls, custom menus and custom toolbars were used. A custom menu and toolbar to organize (save, preview and print) quotations and add/clear or add/retain item to quotation were designed. Dialog boxes (UserForms) are the most important user interface elements in Windows based applications and Excel makes it relatively easy to create custom ones. UserForm controls such as ListBox, Frame, Label and TextBox were developed to custom design the user interface for the Company's quotation for standard die (see Figure Two).

The List Boxes and TextBoxes on the interface allow the user to select the customer name, contact and type, manufacturer's name, manufacturer's representative, regional sales manager, inside sales representative, saw room and inspect/sort activities, number of die per wafer, die size, type of chip trays and whether the transaction is domestic or international, or input the number of die ordered, number of die per wafer, cost per die (cost of materials only), number of receipts, number of shipments, generic part number, customer part number and any comments. All these selections in the ListBoxes are generated from the Microsoft Sequel Server database which can be updated. Through a series of events firing (at workbook, worksheet, application and UserForm levels) triggered by VBA code, the DSS application is able to generate useful outputs via the interface and allows the user to give a more accurate and timely quote to a customer.
Outputs are the three possible unit quote prices per die. Users can select the unit quotation price of their choice. There is also a calculation feature that displays the dollar amount of sales commissions that the sales representative will earn for each quoted price level and the quoted price selected by the user. If the selected price belongs to the range of figures computed by the system, a quote is instantly generated. However, should the selected price fall below the lowest suggested amount, a control feature automatically sends an e-mail message to senior management to request proper authorisation.

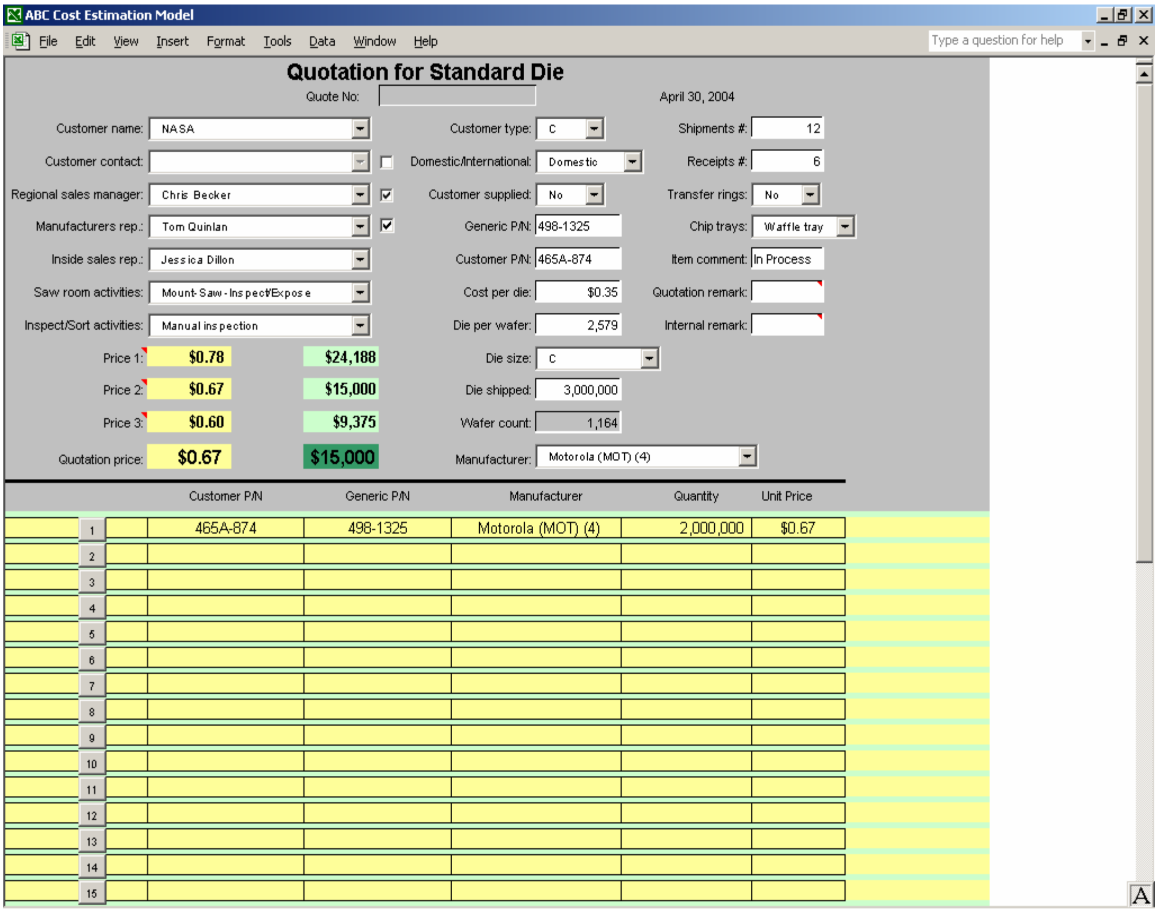
Managerial Impact, Technological Advancement and Future Research

Miller (1996) explains that organizations implement activity-based management – a necessary step towards the development of a DSS based on activity-based costing – because it will help them make better decisions, improve performance, and increase profitability. Regardless of the philosophy that a firm undertakes, information is required to make decisions, set priorities, allocate resources and monitor actions taken. From the list of specific uses of ABM suggested by Miller (1996), we found that the following applied to the Company:

a) to determine product cost, i.e. cost per die, which would lead to better pricing,
b) to improve performance of processes and activities, i.e. bidding in competitive markets and,
c) to determine and optimize activity capacity.

As a result, we argue that the Company has completed a successful ABM implementation.

Figure Two: The DSS Model User Interface



Managerial Impact

The main research purpose of this paper was to demonstrate the benefits of a computer-based information system to make accurate and effective costing and pricing decisions in a competitive environment. Recent management feedback indicates that the implementation of the DSS substantially improved the Company's decision-making process. The implementation process and managerial impact overall have been positive, which reflect information system success (Delone and McLean 1992, 2003) and led to an overall increased profitability, in line with previous research (Ittner et al., 2002). The following statement from management reflects the DSS benefits:

> *"With high competition, profits started declining sharply and there were problems. Designing a computerized DSS using ABC was exactly what we needed".*

The Company has effectively achieved the activity-based management stage. Top management has accepted the DSS and it is currently fully integrated into the Company's decision-making process and operations. In addition, the costs of training and annual maintenance are almost null or very minimal. Except for some initial training time provided by the designer to existing employees as part of the implementation process, no additional staff needed to be hired thanks the user-friendliness of the system designed in Excel and VBA. This added even more to the satisfaction of the Company's management.

Because ABC is considered to be a reliable and effective management accounting costing system, it became an integral component of the DSS. As a reminder, however, prior research indicates that several firms attempted to adopt and implement ABC models, but only a few have actually put them into practice, while others failed to implement ABC productively (Gosselin, 1997; Innes and Sinclair, 2000). Key success factors in ABC are top management support and linkage to competitive strategy (Shields, 1995). These two conditions were present in the Company examined in our case study.

As discussed in previous sections, an example of the decision usefulness of the information generated from the ABC-based DSS is the ability to win bids and thus regain market share. The unit price per die information generated by the system directly impact bidding outcomes, which in turn affect contracts, sales profitability, competitiveness and market share. Low quotes help win bids but hurt profitability whereas quoting too high jeopardize chances to win those bids.

Regarding DSS flexibility or adaptability when estimates or parameters may change as the technology of die improves, management believes it is unlikely that estimates and parameters will change because these constitute measurements of processes. This adds to the robustness of the DSS developed. According to management:

> *"Activities of sawing, carriers, inspection, cleaning and stocking are the same, even with improved die. There are already built-in regressions that cost waffle pack and Gel Pak® die differently and the user can select them from a drop-down box. If the technology was to change drastically, so much that it would affect the processes, some redesigning would need to be done. This part would be fairly easy to do (update parameters within the original DSS) but again, this is unlikely to happen anytime soon*".

Technological Advancement

As a result of its successful DSS implementation, the Company took a step further to undertake an ambitious but worthwhile project. Management approved the conversion of the Excel-based DSS into a Web-based DSS through the Active Server Page (ASP) technology to add remote access functionality[4]. This means that the model's user interface would be available on-line via the Internet, secured by login user name and password. Users, especially sales representatives who travel extensively, will be able to retrieve the same information and outputs, as they would by using the Excel interface. Figure Three depicts a structural design of the Web-based DSS model, while Figure Four shows its user interface. With the Web-based DSS, instant quotes to customers could be generated from any location worldwide with an Internet connection. Current ASP technology and programming made this conversion of interface possible. A pilot version of the ASP interface has already been tested and showed positive results. Accordingly, the Company may take advantage of the widespread availability and power of today's desktop/laptop computers and the Internet. Implications of this conversion and implementation are significant. The benefits of this powerful and novel quote/bid process could place the Company on a global competitive edge of the market.

Limitations and Future Research

The main limitation of the study is that our analysis covers one single company. Although it did allow to learn about valuable in-depth information on the processes involved in a DSS development and implementation based on a management accounting concept, readers need to be take this factor into consideration for generalization purposes. Security access procedures for the Web-based DSS could be examined in future research. Since the database contains sensitive information related to the bidding process, particular attention must be paid when the system is converted into the Web-based application. Traditional internal controls recommend the restriction of access to sensitive information to a very limited number of employees.

[4] For more information on system development using Active Page Server, see Ingram and Lunsford (2003).

Figure Three: The DSS Structural Design

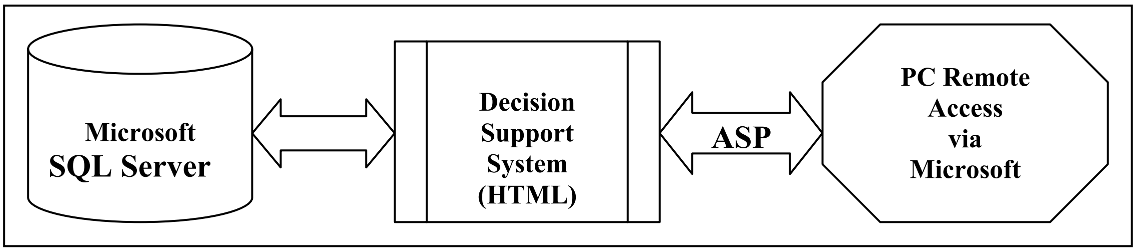
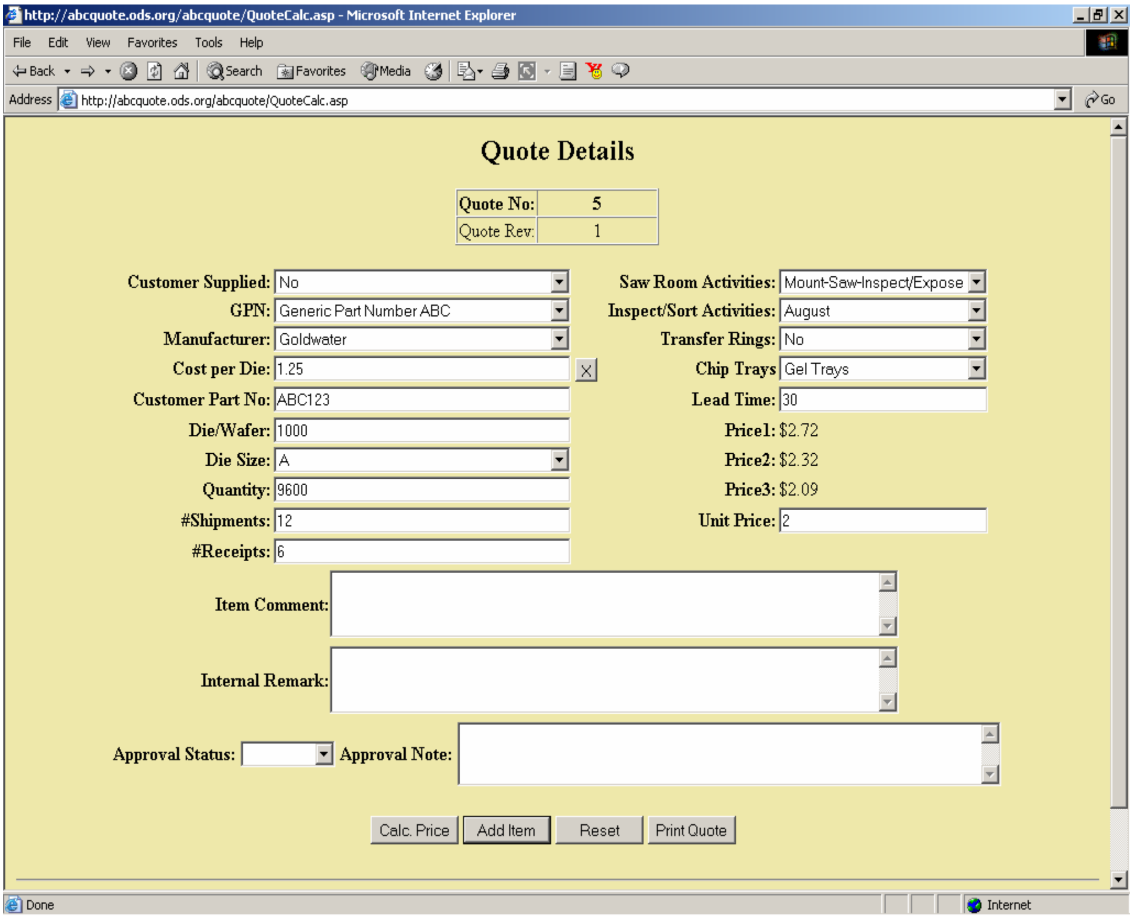


Figure Four: The DSS Model with Web-Based User Interface



Because competitors or other parties could fraudulently access the Web-based DSS by hacking into the system, it is imperative to establish protective measures (such as firewalls) in order to prevent unauthorized access. Investigating data protection procedures such as monitoring the bidding process over a secured Intranet system via dynamic passwords, digital certificates, authentication and data encryption would constitute promising areas in future management accounting and information systems research.

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Appendix One

Name:_____________________________ ___**Clock#:** _____________ **Date:** ________________

Daily Production Report

Please indicate processing step exactly per legend below

(per legend below) (pcs/waf) (min/hrs)

Job #: __________ Step: _____________________ Qty: _____________ Time: ______________
Job #: __________ Step: _____________________ Qty: _____________ Time: ______________
Job #: __________ Step: _____________________ Qty: _____________ Time: ______________
Job #: __________ Step: _____________________ Qty: _____________ Time: ______________
Job #: __________ Step: _____________________ Qty: _____________ Time: ______________
Job #: __________ Step: _____________________ Qty: _____________ Time: ______________
Job #: __________ Step: _____________________ Qty: _____________ Time: ______________

MAKE AN ENTRY TO RECORD THE TOTAL OF ALL UNASSIGNED TIME.

Date completed: ______________________ Total time paid for the day: _______________

Pull this form from job folder prior to sending to Final Q.A. or Shipping.
Forward to XYZ. Thank You!

****

Step Legend: Fill in "step" line detail according to legend below.

"Inspections-A"	means Automatic Inspection on August Tech machine.
"Inspection-M"	means manual visual inspection.
"Audit"	means manual audit inspection.
"Diesort-R6"	means operating Royce pick and place, 6'' machine.
"Diesort-R8"	means operating Royce pick and place, 8'' machine.
"Diesort-M"	means manual pick and place.
"Mount Wafers"	means mounting wafers on film/rings.
"Saw Wafers"	means operating wafer saw and cleaning wafers.
"Transfer Rings"	means transfer wafers from ring to ring.
"Expose Wafers"	means expose wafers to U.V. light to release adhesive.
"Wash Die"	means washing die in chip trays.
"Inking Wafers"	means time spent inking wafers from a map.
"Verify Inking"	means to check accuracy of inking against map.
"UNASSIGNED"	means time here but not on a job; includes break times.

TOTAL MINUTES SHOULD ADD UP TO TIME PAID FOR THAT DAY.
Do not include personal absence time