SMALL MANUFACTURER STRATEGIC DECISION MAKING ASSISTANCE TOOL (SMSDM): A CASE STUDY OF A SMALL OKLAHOMA MANUFACTURER

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MANUFACTURER

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CHAPTER I

PROBLEM STATEMENT

Small businesses in the U.S. create over 50 percent of the domestic non-farm GDP and are directly related to 60 to 80 percent of all new jobs created over the last ten years (smallbusinessnotes.com, 2011). In Oklahoma, there are over 70,973 small employers that account for 94.7 percent of the state's total employees and 54 percent of the state's private sector employment. Of these firms over 3,600 are small manufacturers which are defined as firms with 500 or fewer employees. These firms accounted for around 142,000 jobs in Oklahoma in 2006 (SBA, 2009). In total, the manufacturing sector in Oklahoma employed 9.6 percent of the state's workforce and accounted for 10.4 percent of Oklahoma's GDP (Scott, 2008).

Oklahoma has taken steps to help manufacturers stay competitive and continue to create jobs. Several state and national agencies such as the Oklahoma Center for the Advancement of Science and Technology (OCAST), National Institute of Standards and Technology (NIST), and Oklahoma Department of Commerce (ODOC) fund associations and centers such as the Oklahoma Manufacturing Alliance, Innovation to Enterprise (i2E), Rural Enterprises of Oklahoma (REI), Robert M. Kerr Food &Agricultural Products Center (FAPC), and the Oklahoma State University New Product Development Center (NPDC). These organizations help manufacturers stay competitive by giving advice as well as helping small manufacturers find efficient solutions to problems and issues they face. These problems may range from engineering and design of new products to grant writing assistance to obtain funding for projects (New Product Development Center, 2011). The Oklahoma Manufacturing Alliance offers several services to Oklahoma manufacturers such as company-wide assessments, technical assistance, problem-solving resources, local manufacturing councils, business growth services, lean manufacturing, and assistance in acquiring state incentives.

Even with assistance from these agencies, manufacturers must still make a strategic decision to employ their advice. All of these firms make strategic decisions about how their company is organized, how many are employed, how the company is financed, and which products are manufactured and sold. Many small firms find it difficult to make strategic decisions and to put in place a strategic plan to achieve the goals of their business. Robinson and Pearce (1984) assert firms neglect informed strategic decision making and planning because firm mangers lack 1) time; 2) knowledge of how to get started in the process; 3) broad expertise that may be necessary to make an informed decision and plan; and 4) openness or access to outside advisors. For these reasons many managers have been known to do nothing or accept the first attractive option instead of fully evaluating their possible alternatives (Robinson and Pearce, 1984).

It is important to give small manufacturers a financial analysis that will assist them in the strategic decision making process and allow manufacturers to simulate the financial consequences of business decisions. Simulation of the financial consequences of business decisions will enable manufacturers to first evaluate their current business situation and compare it to alternative simulated business scenarios before making a decision. The goal is to help identify decisions that may lead to desirable outcomes with acceptable risks. To achieve these objectives, the Excel® based program Simetar© is used to conduct stochastic simulation of profitability and cash flow. Simulating a stochastic model in Excel® is accomplished by drawing random values for each of the random variables, letting Excel calculate the model's equations for multiple iterations (Richardson 2005).

Objectives

The primary objective of this thesis is to design an informative analytical financial analysis for a small Oklahoma manufacturing firms that will assist in their strategic planning and decision making processes. The specific objectives are to:

1. Determine the probability of a positive cash flow and profit for a small Oklahoma manufacturer under different product mixes and production practice scenarios;
2. Analyze seasonal sales variability of a small Oklahoma manufacturer and determine its effect on the firm's monthly cash flow and profit given various product mixes and employment strategies; and
3. Determine the importance of variability in prices of key inputs, primarily steel, on cash flow and profit.

CHAPTER II

CONCEPTUAL FRAMEWORK AND HYPOTHESES

Budgeting-based economic-engineering analysis is used in this thesis to build a model that represents a small manufacturer. The economic-engineering technique described by French (1977) has four steps: 1) system description, 2) specification of alternative production techniques, 3) estimation of the production input/output relationships, and 4) synthesis of the cost function. System description is described as the delineation of the firm, with the full specification of the firm's nature and operations to be performed. The specification of alternative production techniques allow for the consideration of multiple production processes that are being considered by firm managers. Estimation of the production function or the "building blocks" is the combination of input/output or production relationships of various operating stages or components (French 1977). These production relationships are the building and equipment capacities and the associated input-output relationship for labor, energy, and materials. Synthesis of the cost function can be performed by applying input prices to the production relationships. Short- run cost functions are obtained by specification of a set of production techniques and their capacities (French 1977).

The economic-engineering technique has been used to create budgets for simulation models of firms to predict financial performance for many years. French (1977) lists more than fifty applications. The development of the microcomputers and associated spread sheet programs has made the modeling of equipment capacities, the associated input/output relationships for labor, energy and materials much easier. Falk, Tilley, and Schatzer used the packing simulation model PACKSIM which was based in spread sheet software Lotus 1-2-3® in the late 1980's. PACKSIM simulated the financial performance of crop packing facilities and allowed the user to run many different simulations in a short time. The PACKSIM users could change various price, quantity, and volume scenarios in a simulated packing facility and see the effects of these changes on profit and cash flow (Falk, Tilley and Schatzer 1987).

Kenkel and Holcomb (2005) have updated the idea into feasibility templates that are based in the computer program Excel®. These feasibility templates work on many of the same basic principles as PACKSIM, but are able to be adapted to cover many different firm types. The templates allow both proposed new firms and existing firms to conduct feasibility assessments. The feasibility temples can be used unmodified for basic feasibility assessments or be modified for more advanced assessments (Kenkel and Holcomb, 2005).

In this thesis a model to assist small manufacturers when evaluating strategic decisions is created by modifying Kenkel and Holcomb's (2005) existing feasibility spreadsheet temple.

The foundation theory is that of a profit maximizing firm from neoclassical microeconomics. Businesses interact with the market to determine pricing and demand and then allocate resources to maximize net profits given capital, labor, and management resources. In the long run, sustainability is the goal of the firm but in the short run the firm's goal is to maximize profit.

Economists use the term theory of the firm in its singular form, but there is no single complex multipurpose theory of the firm that explains all firms' actions and strategies (Grant 1996). The resource-based view of the theory of the firm states that the firm is a unique bundle of resources and capabilities, where the primary task of management is to maximize value through the optimal deployment of existing resources and capabilities, while developing the firm's resource base for the future (Grant 1996). Grant (1996) proposed there was also a knowledge-based theory of the firm. The knowledge-based view relies on the fundamentals of the nature of firm's coordination within an organizational structure, the role of management, the allocation of decision making, and the theory of innovation. Grant (1996) went on to state that, fundamental to a knowledge-based theory of the firm is the assumption that the critical input in production and primary source of value is knowledge.

When using the theory of the firm as a guideline to how a firm will react to different possible production scenarios, the firm will have several alternative profitable product mixes and production practices from which to choose. The firm will most likely chose the product mix that best fits their long-term goals. The probability that the firm will have a positive cash flow for the overall year is expected to be high, but the probability for a positive cash flow may be lower for individual months.

This is particularly true for input supplying agribusinesses because of the seasonality of agricultural production and sales.

The hypotheses are:

1. A budgeting-model-based, economic-engineering analysis to assist small manufactures in strategic decision making is possible and, can be achieved by modifying Kenkel and Holcomb's (2005) existing feasibility spreadsheet template.
2. The firm will have several profitable alternative product mixes and production practices situations. The most likely situation to have the highest potential cash flow will be a mix between existing products and new innovatively designed products.
3. The probability that the firm will have a positive cash flow for the overall year is expected to be high, but the probability of positive cash flow will be lower for individual months.
4. Input price variability will increase monthly cash flow variation in this case study.

To test theses hypothesizes a case study of a small Oklahoma manufacturer is conducted and probabilities for cash flows under different product mixes are calculated.

Methods and Procedures

The methods and procedures for building and simulating annual profitability, monthly cash flows, and cash flow probabilities are presented for a small manufacturer strategic decision making model (SMSDM) in this section. The section covers both the basic version and advanced version of the SMSDM. The basic SMSDM version is an Excel® spreadsheet that is derived from Kenkel and Holcomb's existing feasibility spreadsheet template (Kenkel and Holcomb 2005). Kenkel and Holcomb's existing feasibility template allows firms to simulate annual income, profit and cash flow of new business ventures. The feasibility template provides firms with a 10-year annual income and expense statement with annual cash flow projections for the proposed firm's venture. The feasibility template uses four base input pages: 1) the "Input" sheet is where capital structure information, sales projections, and cost of goods sold data are entered; 2) the"Deprecation" sheet is used for entry of plant and equipment information; 3. the "Personal Expenses" sheet is used for employment information 4. the "Expense Projections" where supplies and miscellaneous expenses are entered. The information from the four input sheets is then used to calculate market projections, depreciation on plant and equipment, and loan amortization (Kenkel and Holcomb 2005). From these calculations annual projected incomes, expenses, and profits statements are created. The feasibility template also gives firms a "Return on Investment" sheet which includes a benefit/cost ratio, internal rate of return, the net present value, and the payback period for the proposed venture (Kenkel and Holcomb 2005).

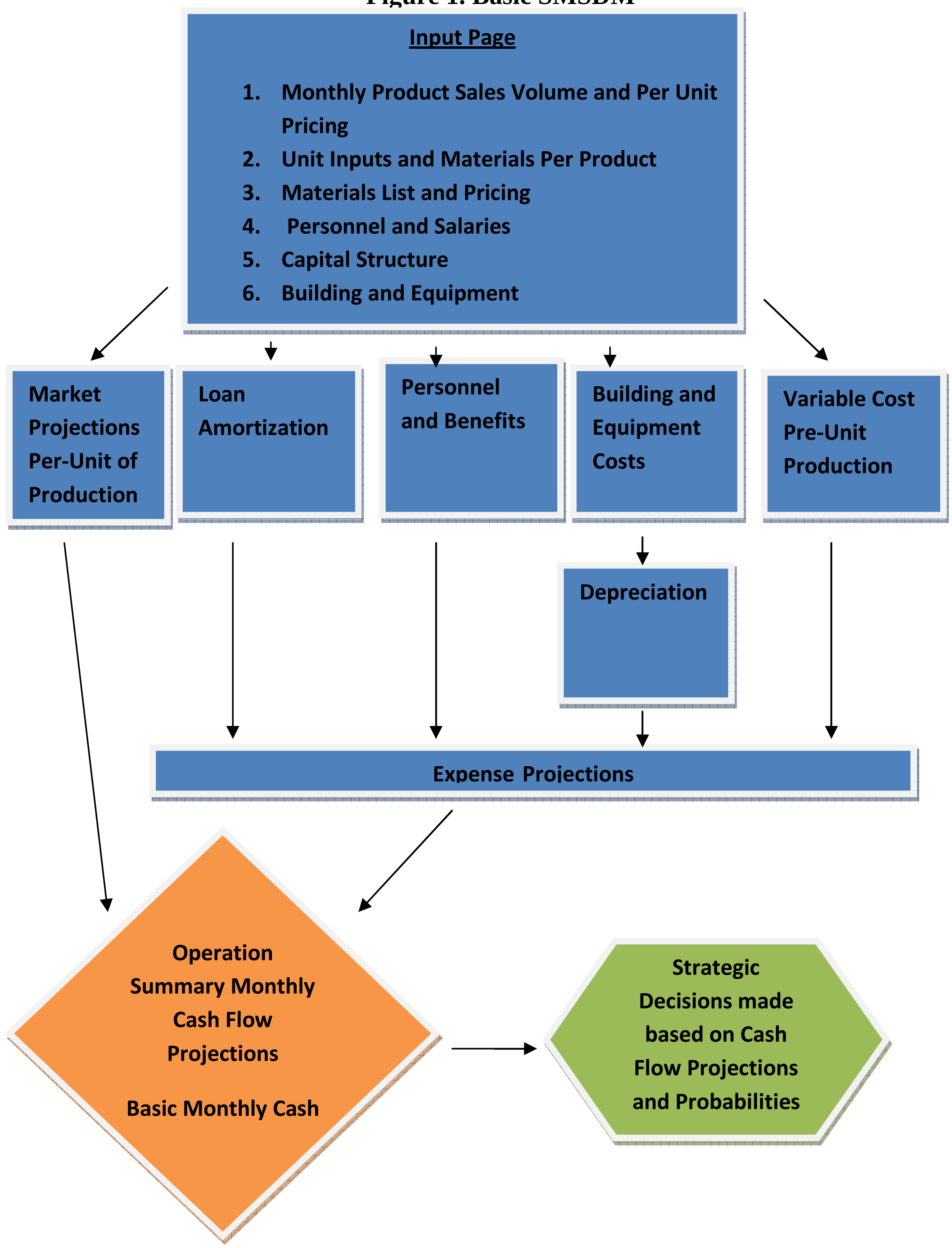
Basic SMSDM

The SMSDM basic version is based on Kenkel and Holcomb's existing feasibility template but uses a single input page rather than three separate pages. The SMSDM basic version adds the ability for users to produce monthly cash flow projections from expected monthly sales of up to fourteen products. The ability to calculate probabilities for monthly cash flows and account for monthly product inventories are also added

Kenkel and Holcomb’s existing feasibility spreadsheet template is modified to better fit the needs of small manufacturers by: 1) expanding the standard feasibility template to fourteen products with the option to use monthly sales data for each; 2) adding the capability to do monthly cash flow and product inventories for the first year; and 3) creating a single input page for all firm information.

Figure 1 illustrates the flow of information thought the basic SMSDM to small manufactures for informed decision making. As shown in the Figure 1, monthly product sales volume, per unit product pricing, unit inputs and materials per product, materials list and pricing , personnel and salaries, building and equipment, and capital structure are input on a single input page into the SMSDM. From the information on the input page, calculations for market projections, depreciation on plant and equipment, variable costs per unit of production, personnel expenses, and loan amortization are used to create expense projections and projected incomes. These projections are the used to create yearly cash flow projections for ten years and monthly cash flow projection for year one. The probability of a negative cash flow for the months in year one are calculated. The cash flow projections and probabilities may then be used by the firm to make informed strategic decisions.

Figure 1. Basic SMSDM



In addition, Kenkel and Holcomb's (2005) existing feasibility spreadsheet template which calculates yearly cash flow projections. The ability to do monthly cash flow projections for the first year was added. This was accomplished by using the following methods and equations.

Profit before Tax

Profit before Tax (PBT_M) is a profitability measure that looks at a company's profits before the company has to pay corporate income tax. This measure deducts total costs (TC_M) from gross sales ($\mathrm{GS_M}$) but it leaves out the payment of tax as shown in equation (1).

$$(1) \qquad PBT_M = \mathrm{GS_M} - TC_M$$

After Tax Profit

After tax profit (ATP_M) is the firms total monthly earnings, reflecting revenues adjusted for costs of doing business, depreciation, interest, taxes and other expenses for the given period. After tax profit (ATP_M) is calculated by subtracting taxes (Tax_M) form profit before tax (PBT_M) as shown in equation (2).

$$(2) \qquad ATP_M = PBT_M - Tax_M$$

Monthly Cash Flow

Cash flow refers to the relationship between money inflows and outflows in a specific month. Monthly cash flow (MCF_M) is the summation of after tax profit (ATP_M) and depreciation ($\overline{DEP}_M$) with principle (PRI_M) subtracted out for the given month as shown in equation (3).

$$(3) \qquad MCF_M = ATP_M + \overline{DEP}_M - PRI_M$$

Gross Sales

Monthly gross sales (GS_M) are the combined sales for all products in the given month as shown in equation (4),

$$(4) \qquad GS_M = \Sigma_i \, (P_{iM} * Q_{iM})$$

where M is month, i is product, P_{iM} is product price for product i in month M, and Q_{iM} is quantity produced of product i in month M.

Variable Costs

Monthly production expense (PE_M) is the total production expense (materials) for all products built in the given month as shown in equation (5),

$$(5) \qquad PE_M = \Sigma_i \, (E_{iM} * Q_{iM})$$

where M is month, i is product, E_{iM} is materials cost based on economic-engineering calculations for product i in month M, and Q_{iM} is product i quantity for month M. Labor ($\overline{L_M}$) is based on a fixed monthly employment as shown in equation (6),

$$(6) \qquad \overline{L_M} = \Sigma_n \, (S_{nM} * W_{nM})$$

where M is month, n is worker classification, S_{nM} is worker salary for worker classification n in month M, and W_{nM} is number of workers with the classification of n in the M month.

Monthly utilities expense (U_M) is the total utility expense incurred by the firm in a given month. Total variable cost (TVC_M) includes the expenses that vary in direct proportion to the quantity of the products produced. TVC_M is a direct function of production volume, rising when production increases and falling when production volume decreases. TVC_M for a given month can be calculated from the summation of the total production expenses (PE_M), labor expense ($\overline{L_M}$), and utilities expense (U_M) as shown in equation (7).

$$(7) \qquad TVC_M = PE_M + \overline{L_M} + U_M$$

<u>Fixed Costs</u>

Monthly equipment and plant maintenance expense ($\overline{EPME_M}$) is calculated as a percentage of the total dollar amount of both equipment and plant facilities. In this model $\overline{EPME_M}$ is set at a fixed amount per month based on a percentage of yearly total dollar value as shown in equation (8),

$$(8) \qquad \overline{EPME}_M = (PRM_t * TPE_t)/12$$

where t is time period of a year, M is month, PRM_m is percentage chosen for maintenance costs by firm in the year t, and TPE_t is total dollar amount of plant and equipment year t. Monthly cost for insurance ($\overline{INS}_M$) and monthly property taxes ($\overline{PT}_M$) is also calculated as a percentage of total plant and equipment as shown in equation (9),

$$(9) \qquad \overline{INS}_M = (PRI_t * TPE_t)/12$$

where t is year, M is month, PRI_t is percentage chosen for insurance costs by firm for year t, and TPE_t is total dollar amount of plant and equipment year t as shown in equation (10),

$$(10) \qquad \overline{PT}_M = (PRT_t * TPE_t)/12$$

where t is time period of a year, M is month, PRT_t is percentage chosen for property tax for year t, and TPE_t is total dollar amount of plant and equipment year t. Monthly depreciation ($\overline{DEP}_M$) is calculated subject to building type (special propose or standard buildings), equipment, and vehicles. Standard buildings are depreciated using thirty nine year straight line deprecation while special propose building, equipment, and vehicles are deprecated using the reducing balance method of deprecation. This method deprecates items faster at the beginning and slower at the end of their life cycle as shown in equation (11),

$$(11) \quad \overline{DEP_M} = (D_{tb} + D_{tsp} + D_{te} + D_{tv})/12$$

where t is year, M is month, D_{tb}, deprecation buildings for year t, D_{tsp} is deprecation special propose buildings for year t, D_{te} is depreciation on equipment for year t, and D_{tv} is deprecation vehicles for year t. Monthly interest costs for loans ($\overline{INT_M}$) is the total interest charge in the given time period for working capital loans and percent of the firm that is financed as shown in equation (12),

$$(12) \quad \overline{INT_M} = (WC_t + FF_t)/12$$

where t is time period of a year, M is month, WC_t is working capital loan interest for year t, and FF_t is firm financed loan interest for year t.

Total Fixed Costs (TFC_M) for the given time period can be calculated from the summation of the time periods monthly equipment and plant maintenance expense ($\overline{EPME_M}$), insurance ($\overline{INS}_M$), monthly property taxes ($\overline{PT}_M$), monthly depreciation ($\overline{DEP}_M$), and monthly interest costs for loans ($\overline{INT_M}$) as shown in equation (13).

$$(13) \quad TFC_M = \overline{EPME_M} + \overline{INS}_M + \overline{PT}_M + \overline{DEP}_M + \overline{INT_M}$$

<u>Other Cost</u>

Total Other Cost (OC_M) may include miscellaneous cost such as patents fees, research and development expenses, and attorney fees.

<u>Total Costs</u>

Total Cost (TC_M) describes the total economic cost of production and is made up of Total Variable Cost (TVC_M), which varies according to the quantity of each product produced and, includes inputs such as total Production Expenses (PE_M), Labor expense ($\overline{L_M}$), and Utilities expense (U_M). Total Cost (TC_M) also includes Total Fixed Costs (TFC_M),which are independent of the quantity of a product produced and includes inputs that cannot be varied in the short term, such as monthly equipment and plant maintenance expense ($\overline{EPME_M}$), insurance ($\overline{INS_M}$), monthly property taxes ($\overline{PT_M}$), monthly depreciation ($\overline{DEP_M}$), and monthly interest costs for loans ($\overline{INT_M}$). TC_M is calculated as the summation of all cost for a given time period. Total costs includes Total Variable Cost (TVC_M), Total Fixed Costs (TFC_M), and Total Other Cost (OC_M) as shown in equation (14).

$$(14) \quad TC_M = \mathrm{TVC_M} + TFC_M + \mathrm{OC_M}$$

Equations (1) through (14) represent firms that manufacturer products to order and have just in time inventory. If the firm uses straight line production and keeps a standing inventory of products the flowing equations (15) and (16) are required in addition to equations (1) through (14).

Inventory (IN_M) is the number of unsold good a firm has on hand in a give time period as shown in equation (15),

$$(15) \quad IN_{Mi} = H_{M-1i} + P_{Mi}$$

where M is month, i is product, H_{M-1i} is holdover from previous time period or being inventory for month M for product i, and P_{Mi} is production of product for the month M of product i. Gross sales is constrained by the inventory the firm has on hand for the given time period as shown in equation (16). This equality shows that gross sales can only be less than or equal to the firm’s inventory for the time period.

$$(16) \quad GS_{Mi} \leq IN_{Mi}$$

To confirm the equation for monthly cash flow (MCF_m), the outputs of the monthly cash flow projections of the SMSDM were compared with the existing yearly cash flow (YCF_t) projections generated by Kenkel and Holcomb's (2005) existing feasibility spreadsheet template as shown in equation (17).

$$(17)\ \sum_{M=1}^{12} MCF_M = YCF_t$$

where t is year, M=month, MCF_M=monthly cash flow, and YCF_t=yearly cash flow. These comparisons show the equations were correct and did yield the same results.

Advanced SMSDM

The advanced SMSDM requires the Excel® based program Simetar©. Simetar© allows the program to simulate monthly cash flows based on monthly sales and input price data. The program also gives the advanced version of the SMSDM the ability to perform risk analysis for monthly cash flows.

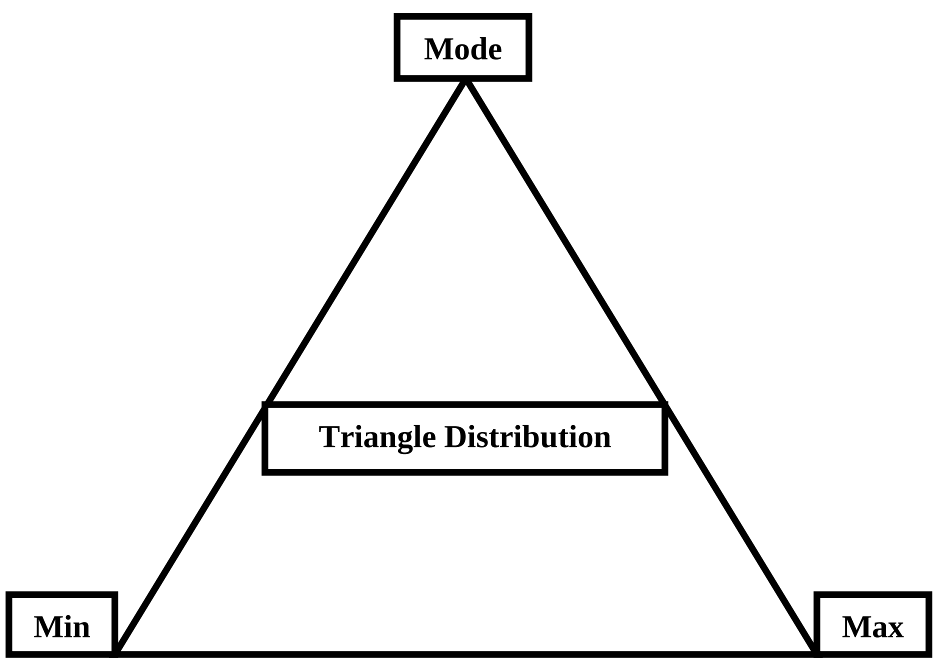
Simetar© was developed in 1997 at Texas A&M University by James W. Richardson, Keith D. Schumann and Paul A. Feldman. The software was initially developed to provide simulation and graphical analysis tools for conducting risk analysis of policy changes on agribusinesses. Simetar© is a simulation language written for risk analysts to provide a clear method for analyzing data, simulating the effects of risk, and presenting results in the user friendly environment of Excel© (Richardson 2005). The advanced version of the small manufacturer strategic decision making model uses Simetar© for empirical and trianglular distribution tools and scholastic simulation functions to evaluate financial risks and outcomes.

Figure 3 illustrates the flow of information thought the advanced SMSDM to small manufacturers for informed decision making. As shown in the Figure 3, the information such as monthly and yearly product sales volume data, per unit pricing, product materials lists, input prices, personnel and salaries, capital structure, and building and equipment are input into the SMSDM. From the information on the input page, calculations for market projections, depreciation on plant and equipment, variable costs per unit of production, personnel expenses, and loan amortization are used to simulate monthly sales and monthly input prices. A trianglular distribution based on annual sales data is used to simulate annual sales for products produced as shown in equation (16),

$$(16) \qquad (Triangle\ Distribution)\ Triangle = (Min,\ Mode, \text{Max})$$

where Min is the minimum value for the distribution, Mode is the mode of the distribution, and Max is the maximum value for the distribution as show in Figure 2 Triangle distributions work well in instances where there are little data available (Richardson 2005).

Figure 2 Triangle Distribution



Monthly sales data is used to simulate the seasonal sales cycle for the products. The simulated annual sales are then adjusted to a monthly sales volume to fit the seasonal sales cycle as shown in equation (17),

$$(17) \quad Monthly\ Producbt\ Line\ Sales_M = YTS_{ti} * MP_{Mi}$$

where M is month, i is product line, t is year, YTS_{ti} is yearly total sales generated from triangle distribution, and MP_{mi} is monthly percent sales based on products season sales cycle. An empirical distribution based on annual input price data is used to simulate annual average priced for inputs as shown in equation (18),

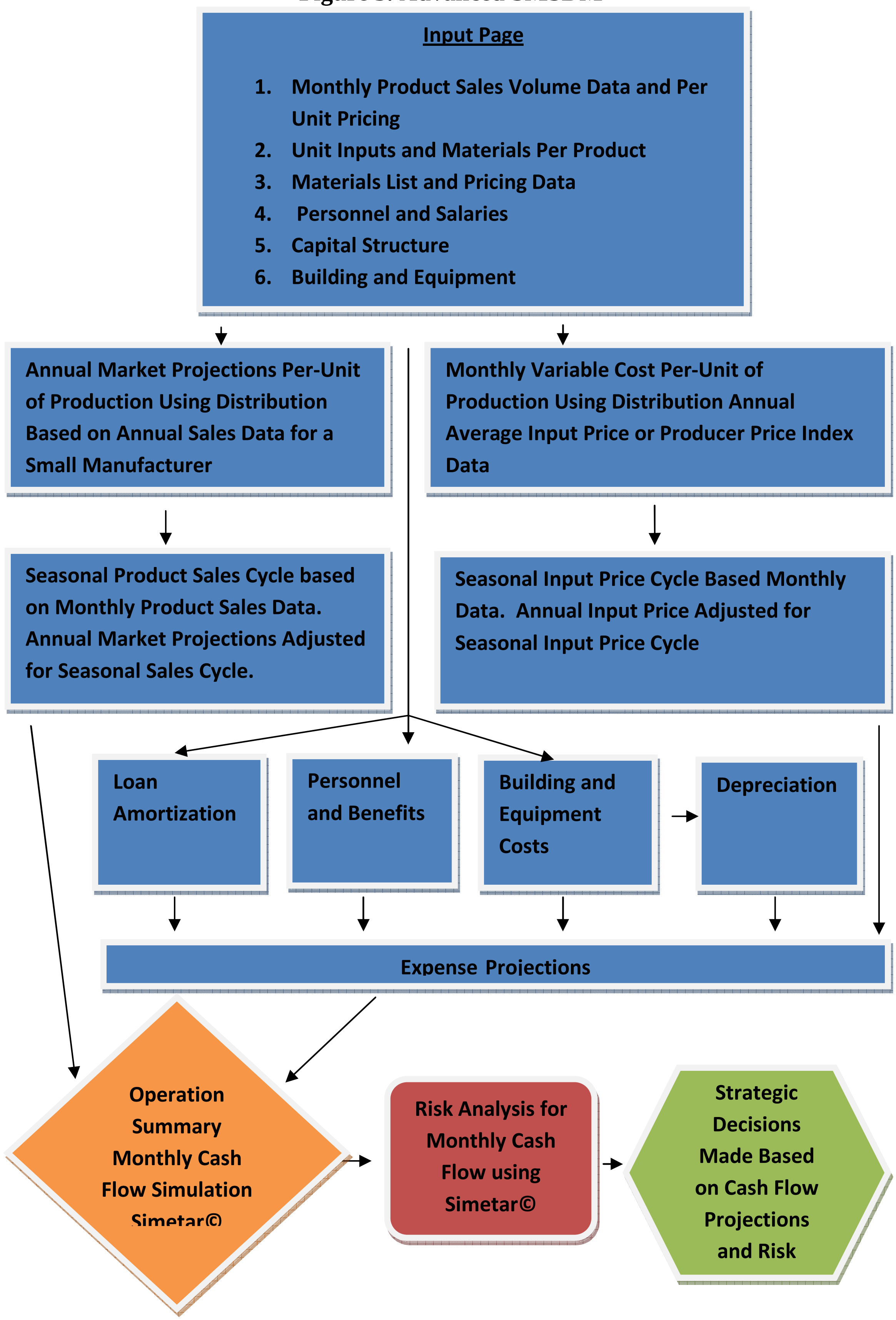
$$(18) \quad (Empirical\ Distribution)\ EMP_t = (S_t, F(S))$$

where t is yearly average price index, S_t is n sorted random values including min and max from input price data and F(S) is cumulative probability for the S values, including the end points of zero and one (Richardson 2005). Monthly input pricing data is used to simulate the seasonal pricing cycle for inputs. In the SMSDM simulation, the current annual prices for inputs are adjusted by the annual input price index generated by the empirical distribution. The adjusted input price is then adjusted for the monthly price cycle as shown in equation (19).

$$(19) \quad Monthly\ Input\ Prices_M = (YA * AASIP) * PRSC_M$$

Where M is month, YA is yearly annual price index generated, AASIP is actual annual steel input price for current year, and $PRSC_M$ is percent change for monthly adjustment form yearly steel cycle. These simulations and the information from the input page are used to produce expense projections and projected income statements. These projections are then used to create yearly cash flow projections for ten years and monthly cash flow projection for year one. Probabilities are calculated with the program Simetar© for positive monthly and year one annual cash flows. The cash flow projections and probabilities may then be used by the firm to make informed strategic decisions.

Figure 3. Advanced SMSDM



CHAPTER III

SMSDM CASE STUDY

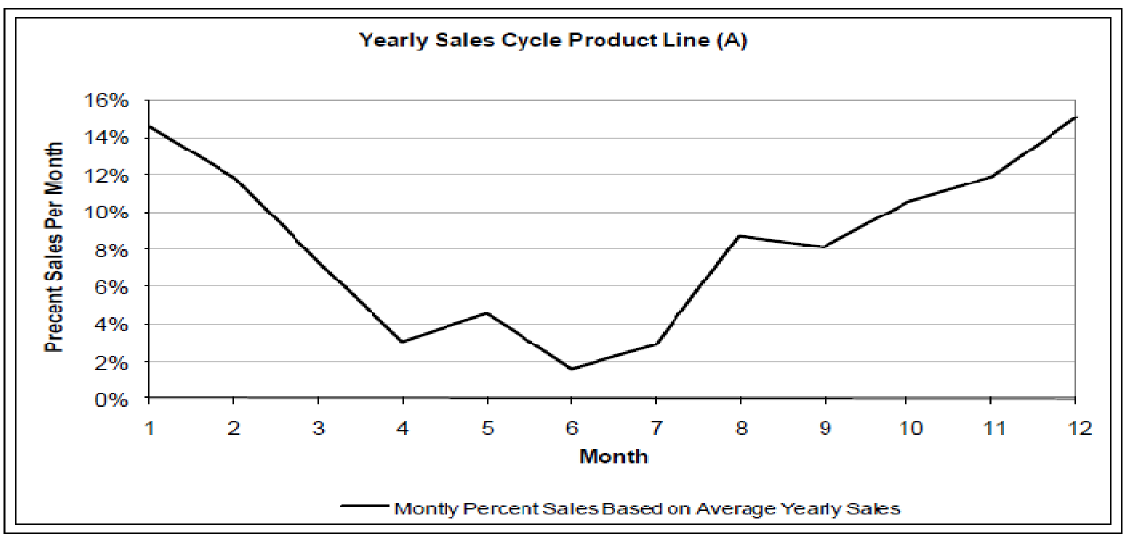
The advanced version of SMSDM in conjunction with Simetar© was used perform simulations for case study of a small Oklahoma manufacturer. The simulations and data used in this thesis for the SMSDM case study are illustrative of a firm's actual situation but have been modified to protect the firm's financial data. The case study firm has three current product lines A, B, and C and one proposed product line A1 that would potentially take the place of product line A. Product line A1 is a redesigned version product line A that would require less labor per unit of output. Product line A consists of six product models which are distinguished by a bulk capacity rating. Product lines B and C both consist of one product model. Product line A1 is assumed to have the same product line models as product line A. Product lines A, B and proposed product lines A1 are product lines built for the agricultural industry. Product line C is a product line for school athletics and sports storage. For more information on case study product lines is included in Table 1. Sales data received from the case study firm revealed that product lines A and B have distinct seasonal sales patterns. Product line A has a sales pattern that peaks in the winter months, declines greatly in the spring, is stagnant during the summer, and greatly increases in the fall as show in Figure 4.

Table 1. Oklahoma Small Manufacture
Current and Proposed Products Spring (2011)

Product Line	Target Industry	Number of Models
(A)	Agriculture/Cattle Feeding	6
(B)	Agriculture/Cattle Feeding	1
New Product Line	**Target Industry**	**Number of Models**
(C)	School's /Athletics	1
Proposed Product	**Target Industry**	**Number of Models**
(A1)	Agriculture/Cattle Feeding	6

Product line (A1) is a proposed replacement for product line (A). Product line (A1) is expected to require less labor. Product line (C) is a new product line that has been in production for 1 year.

Figure 4. Yearly Sales Cycle in Average Percent Monthly Sales Product Line A



Product line B data showed that its sales peaked at the end of spring/beginning of summer, declined during the summer, and peaked again at the end of summer/beginning of fall and then declined during the winter months as shown in Figure 5.

Product line C had no data to establish an annual sales pattern. The case study firm assumes that the majority of sales for product line C are during the summer months, peaking in June and July with these months accounting for 40 percent of total sales for product line C. These product lines sales patterns and assumptions were used in the simulations that were conducted for the case study firm.

Case study assumptions are as follows:

1. Product line A1 is expected to use less labor and have the same yearly sales cycle as product line A. Product line A1 is assumed to eliminate two employment positions in manufacturing due to a more efficient product design. It is also assumed that product line A1 will seamlessly replace product line A and therefore follow the same sales patterns.
2. Product line C is expected to have a yearly sales cycle that peaks during the months of June, July and August because of the summer shutdown periods of schools that allow this product to be installed and not hinder operations during school sessions. This is illustrated in Figure 6.

Figure 5. Yearly Sales Cycle in Average Percent Monthly Sales Product Line B

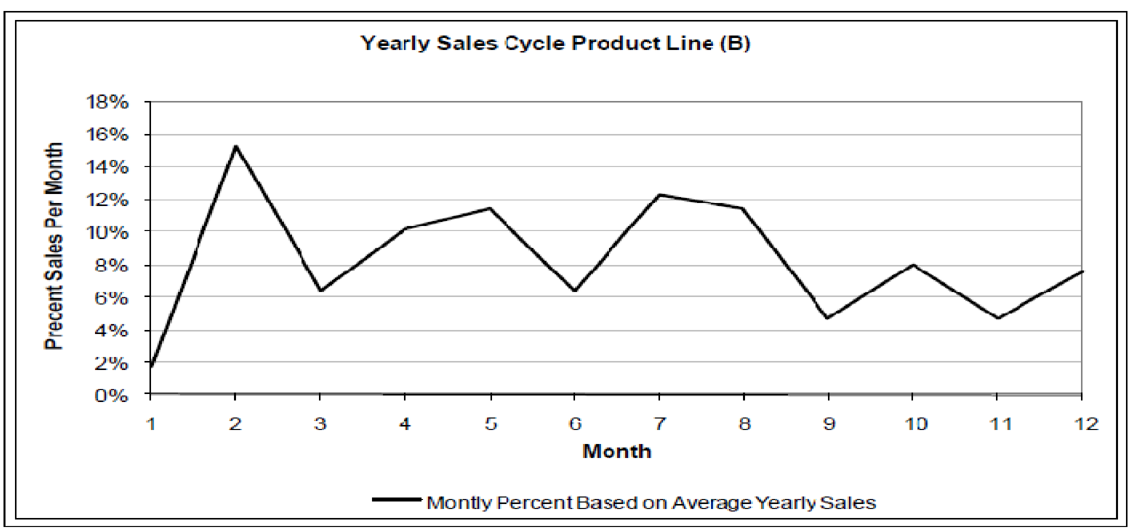
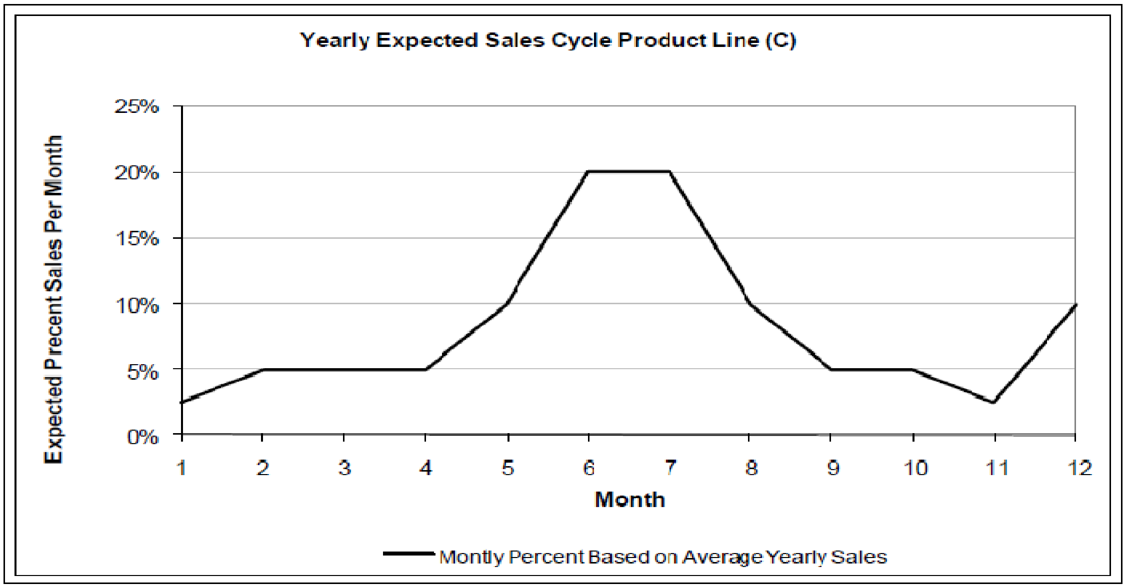


Figure 6. Expected Yearly Sales Cycle in Average Percent Monthly Sales Product Line C



Monthly sales and price data for product lines A and B for 2008, 2009, and 2010, from the case study firm, are used in the case study to simulate monthly sales. A triangle distribution was used in the SMSDM to generate a yearly average sales total for product lines A and B. To generate these annual totals, yearly sales data was used for these product lines as shown in Tables 2 and 4. The generated yearly totals for each product line included in the model. The yearly totals are adjusted by the yearly sales cycle for their perspective product lines. This allowed the model to both simulate yearly sales variability as well as hold true to each product's lines yearly sales cycle. Tables 2 and 4 show yearly and Tables 3 and 5 show monthly sales cycles. Figures 4, 5, and 6. show yearly sales cycles. Figure 8 is an illustration of how the case study information included in this section flows thought the advanced SMSDM to small manufactures for informed decision making.

Table 2. Product Line (A) Yearly Sales Summary Statistics
Oklahoma Small Manufacture Yearly Sales Data (2008-2010)

Year	Sample Size	Sample Mean	Median	Standard Deviation	Maximum	Minimum	Totals
2008	12.00	29.50	26.50	17.88	65.00	6.00	354
2009	12.00	22.42	18.00	15.23	47.00	3.00	269
2010	12.00	27.17	28.00	16.54	58.00	3.00	326
					Ave. Total Sales Yearly		316.3

Table 3. Product Line (A) Monthly Sales Summary Statistics
Oklahoma Small Manufacture Monthly Sales Data (2008-2010)

Month	Sample Size	Sample Mean	Median	Standard Deviation	Maximum	Minimum
Jan	3.00	46.00	42.00	17.35	65.00	31.00
Feb	3.00	37.33	40.00	5.51	41.00	31.00
Mar	3.00	23.00	23.00	5.00	28.00	18.00
Apr	3.00	9.67	10.00	1.53	11.00	8.00
May	3.00	14.33	16.00	4.73	18.00	9.00
Jun	3.00	5.00	3.00	3.46	9.00	3.00
Jul	3.00	9.00	7.00	4.36	14.00	6.00
Aug	3.00	27.67	25.00	11.24	40.00	18.00
Sep	3.00	25.67	27.00	18.04	43.00	7.00
Oct	3.00	33.33	29.00	12.10	47.00	24.00
Nov	3.00	37.67	34.00	7.23	46.00	33.00
Dec	3.00	47.67	50.00	11.68	58.00	35.00

Table 4. Product Line (B) Yearly Sales Summary Statistics
Oklahoma Small Manufacture Yearly Sales Data (2008-2010)

Year	Sample Size	Sample Mean	Median	Standard Deviation	Maximum	Minimum	Totals
2008	12.00	9.50	9.00	6.67	25.00	0.00	114
2009	12.00	4.67	5.00	2.84	9.00	0.00	56
2010	12.00	5.50	5.00	3.83	12.00	0.00	66
					Ave. Total Sales Yearly		78.7

Table 5. Product Line (B) Monthly Sales Summary Statistics
Oklahoma Small Manufacture Monthly Sales Data (2008-2010)

Month	Sample Size	Sample Mean	Median	Standard Deviation	Maximum	Minimum
Jan	3.00	1.33	0.00	2.31	4.00	0.00
Feb	3.00	12.00	6.00	11.27	25.00	5.00
Mar	3.00	5.00	5.00	4.00	9.00	1.00
Apr	3.00	8.00	9.00	2.65	10.00	5.00
May	3.00	9.00	7.00	4.36	14.00	6.00
Jun	3.00	5.00	6.00	1.73	6.00	3.00
Jul	3.00	9.67	11.00	6.11	15.00	3.00
Aug	3.00	9.00	9.00	0.00	9.00	9.00
Sep	3.00	3.67	5.00	3.21	6.00	0.00
Oct	3.00	6.33	5.00	4.16	11.00	3.00
Nov	3.00	3.67	2.00	4.73	9.00	0.00
Dec	3.00	6.00	5.00	5.57	12.00	1.00

Bureau of Labor Statistics (BLS) Producer Price Index (PPI)-Commodities (2004-2010) data for steel products are used to simulate monthly steel prices in an empirical distribution for the case study. Bureau of Labor Statistics (BLS) Producer Price Index (PPI)-Commodities (2004-2010) data for steel products are used to simulate monthly steel prices in an empirical distribution for the case study. The PPI measures the average change over time in the selling prices received by domestic producers for their output. The prices included in the PPI are from the first commercial transaction for products. The data for the (PPI) is collected by a BLS survey via systematic sampling, from a listing of all firms that file with the unemployment insurance system (Bureau of Labor Statistics, 2011). An empirical distribution is used to generate yearly averages for the producer price index for steel. These averages are based on annual data form Bureau of Labor Statistics PPI-Commodities (2004-2010) for steel products. The yearly average form the empirical distribution is then used to adjust the annual average price of all steel inputs. Once adjusted the steel inputs prices are then used to generate monthly steel price. This is accomplished by adjusting the new steel prices by the yearly steel price index cycle as show in Figure 7. By using this method of adjusting steel price we are able to capture both the variability in annual steel prices and as well as the seasonal price cycle. Tables 6 and 7 have summary statistic for the PPI for steel adjusted to the base year of 2010.

Figure 7. Yearly Steel Price Index Cycle

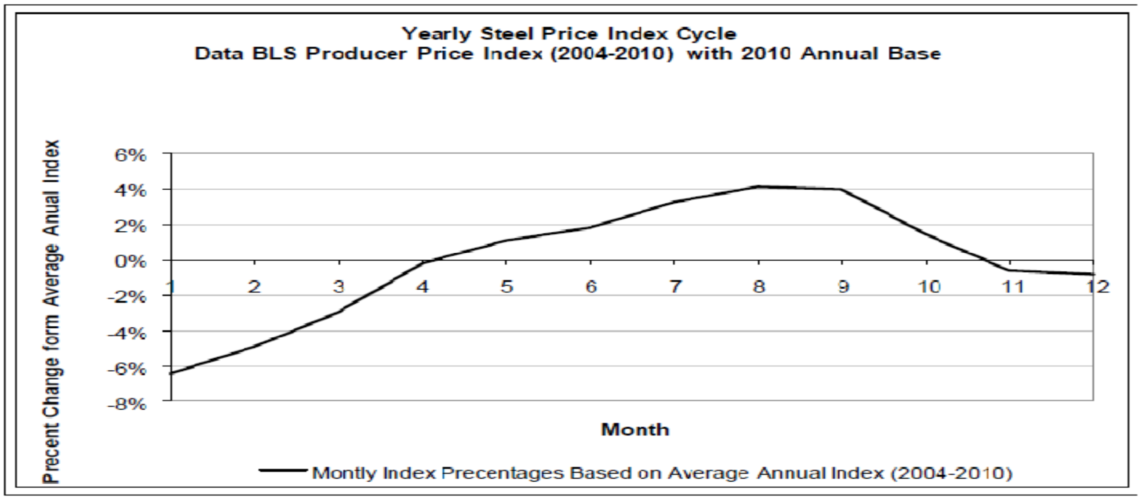


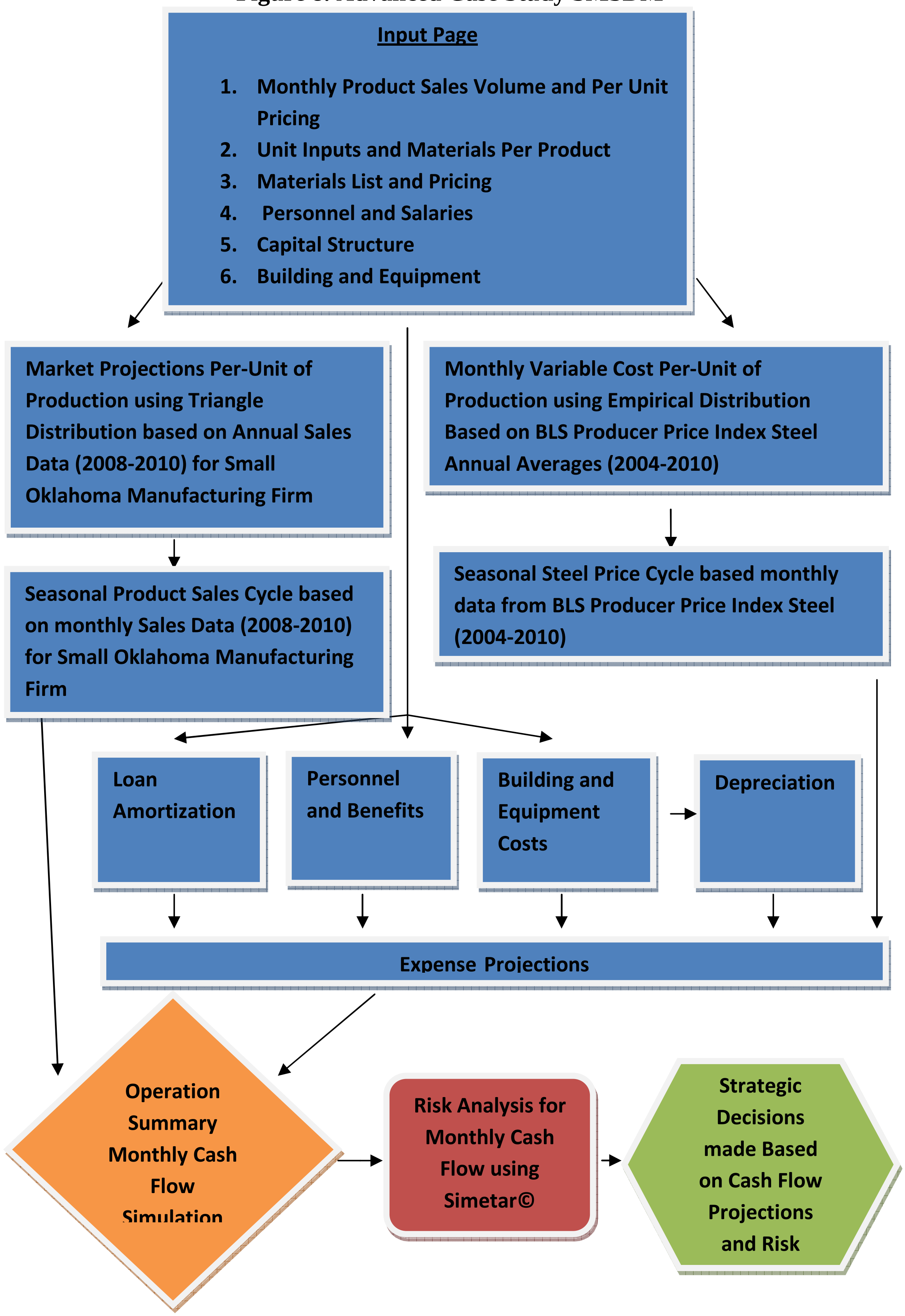
Table 6. Bureau of Labor Statistics Steel Producer Price Index Monthly Summary Statistics Bureau of Labor Statistics Data (2004-2010) with 2010 Annual Base of 1.00

Month	Sample Size	Sample Mean	Median	Standard Deviation	Maximum	Minimum
Jan	7.00	0.82	0.85	0.11	0.94	0.60
Feb	7.00	0.83	0.83	0.11	0.96	0.64
Mar	7.00	0.85	0.80	0.12	1.00	0.67
Apr	7.00	0.88	0.81	0.16	1.12	0.69
May	7.00	0.89	0.82	0.19	1.21	0.69
Jun	7.00	0.89	0.84	0.20	1.27	0.69
Jul	7.00	0.91	0.87	0.20	1.31	0.71
Aug	7.00	0.91	0.86	0.20	1.31	0.72
Sep	7.00	0.91	0.87	0.16	1.22	0.76
Oct	7.00	0.89	0.88	0.11	1.05	0.75
Nov	7.00	0.87	0.85	0.07	1.00	0.78
Dec	7.00	0.87	0.87	0.08	1.02	0.78

Table 7. Bureau of Labor Statistics Steel Producer Price Index Yearly Summary Statistics Bureau of Labor Statistics Data (2004-2010) with 2010 Annual Base of 1.00

Year	Sample Size	Sample Mean	Median	Standard Deviation	Maximum	Minimum
2004	12.00	0.73	0.72	0.07	0.81	0.60
2005	12.00	0.76	0.77	0.03	0.81	0.71
2006	12.00	0.83	0.84	0.03	0.87	0.78
2007	12.00	0.90	0.90	0.02	0.93	0.85
2008	12.00	1.10	1.09	0.16	1.31	0.87
2009	12.00	0.82	0.83	0.05	0.88	0.75
2010	12.00	1.00	1.00	0.04	1.05	0.92

Figure 8. Advanced Case Study SMSDM



CHAPTER IV

FINDINGS

The creation of an informative analytical tool for small Oklahoma manufacturing firms to assist in their strategic planning and decision making processes was successfully created by modifying Kenkel and Holcomb's (2005) existing feasibility spreadsheet template. Both the basic and advanced version of the SMSDM tool produces monthly cash flow and yearly cash flow projections. Basic SMSDM allows the firm to do basic cash flow projections based on limited information about monthly product sales volume and price per-unit, personnel and salaries, capital structure, buildings and equipment, and materials. and pricing information for inputs and outputs. The advanced SMSDM uses the same information but adds the capabilities of Simetar©. Simetar© allows the user to run simulations of the firms cash flows and calculate probabilities of having a positive monthly cash flow as well as a positive cash flow for the year.

SMSDM Case Study Simulations

In simulations one through three the case study firm it is assumed that the firm manufacturers products when orders are received and uses just in time inventory. With this assumption the firm has no inventory of products or inputs. All products are built to meet orders and parts are purchased as need to produce the ordered products. Simulations four through six simulate assume that the case study firm produces the same amount of each product each month and has an inventory of products which sales cannot exceed. The assumptions for straight line production is that the firm can produce a set amount of products in a given time period and the production of the products is not dependent on sales. This allows the firm to build inventory in low sales months and meet demand in high sales months by selling from accumulated inventory. Table 8 shows further information on case study simulations one through six. For each simulation, probabilities for a cash flow above $5,000, probabilities for a cash flow between $5,000 and $0.00, and the probability of a cash flow bellow $0.00 were calculated and are presented in stoplight graphs (Richardson et al., 2005). Summary statistics for each simulation are also presented.

Table 8. SMSDM Case Study Simulations

X Indicates Prodcut Lines and Production Staratigies Included in Each Case Study Simulation

	Simulation One	Simulation Two	Simulation Three	Simulation Four	Simulation Five	Simulation Six
Product Line (A)	X	X		X	X	
Product Line (A1)			X			X
Product Line (B)	X	X	X	X	X	X
Product Line (C)		X	X		X	X
Build to Order	X	X	X			
Inventory				X	X	X

Simulation One

In simulation one simulate cash flows and year one annual cash flow for the case study firm, are simulated as if the firm only produces product lines A and B, without maintaining inventory. Simulation one results show that with both products lines A and B in production the case study firm has a 100 percent probability of a positive annual cash flow in the first year with an average year one annual cash flow of $106,684.23. January, February, August, October, November and December were all found to have 100 percent probabilities of a positive cash flow above $5,000. March had a 5 percent probability of a cash flow above $5,000, an 85 percent probability of a cash flow between $0.00 and $5000, and a 10 percent probability chance of a negative cash flow. The probability of a positive cash flow for September was 20 percent, 77 percent probability of a cash flow between $0.00 and $5,000, and a 3 percent chance of a negative cash flow. The months of April, June, and July have 100 percent probability of negative cash flows with the month of May having a 99 percent probability of a negative cash flow and a 1 percent chance of a positive cash flow for the month as shown in Table 9.

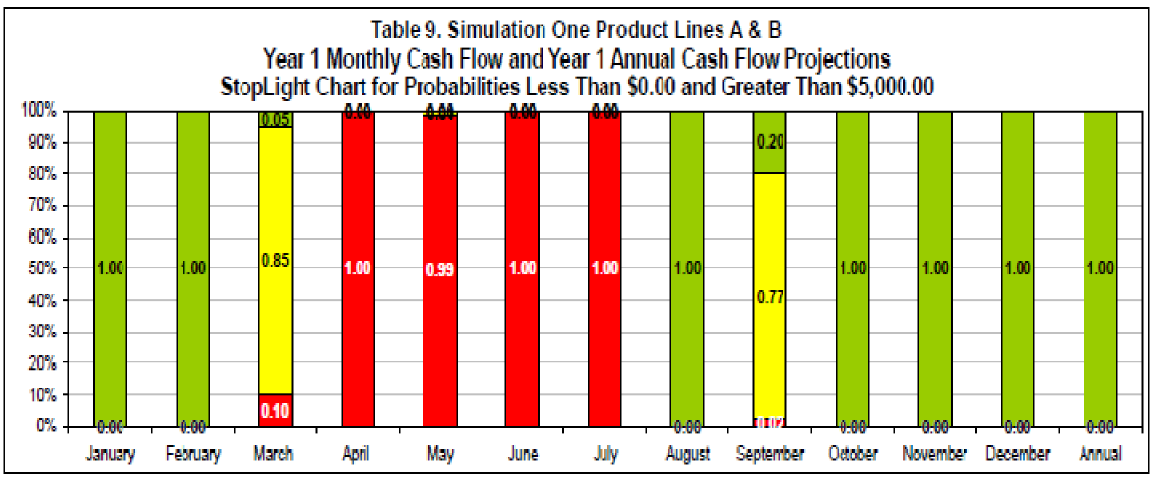


Table 9. Simulation One Product Lines A & B
Year 1 Monthly Cash Flow and Year 1 Annual Cash Flow Projections
StopLight Chart for Probabilities Less Than $0.00 and Greater Than $5,000.00

The summary statistics in Table 10 show that if the case study firm were only to produce product lines A and B they would require access to capital to operate during the months of April, May, June, July, and possibly March and September. This capital may be attained by retaining capital from more profitable months. As shown in Table 10 the month of April could require up to $15,847.71 in capital to sustain the case study firm for the month. The month of May $9,297.01, June $24,670.42, July $15,424.84, and finally

September could require up to $1,637.28 and March $2,811.03 in funds to continue operations. In this simulation it would be important for the case study firm to have access to readably available capital for the summer months. The cumulative cash flow for the simulation is positive for the year and shows the firm can use accumulated capital to sustain the firm in negative cash flow months.

Table 10. Summary Statistics Simulation One Monthly Cash Flows And Annual Cash Flow Year One Projections

Time Period		Mean		Min		Max	Standard Deviation
January	$	29,010.14	$	19,804.00	$	37,247.92	3295.01
February	$	32,414.78	$	21,528.96	$	43,863.80	3714.84
March	$	2,271.59	$	(2,811.03)	$	7,430.06	1730.75
April	$	(11,941.55)	$	(15,847.71)	$	(7,251.96)	1560.84
May	$	(4,238.00)	$	(9,297.01)	$	1,635.26	1925.50
June	$	(22,700.44)	$	(24,670.42)	$	(20,408.08)	807.94
July	$	(10,755.82)	$	(15,424.84)	$	(5,126.89)	1891.17
August	$	13,634.40	$	6,016.18	$	21,755.79	2624.03
September	$	3,458.43	$	(1,637.28)	$	8,505.07	1786.96
October	$	17,910.72	$	10,259.71	$	25,657.28	2640.86
November	$	20,273.77	$	12,527.69	$	27,740.50	2727.06
December	$	37,346.20	$	26,856.58	$	47,726.92	3693.35
Annual	$	106,684.23	$	30,188.43	$	185,746.57	26057.84

Simulation Two

In simulation two, monthly cash flows and year one annual cash flow for the case study firm is simulated if produced product lines A B and C are produced and no inventory is maintained. In simulation two, the case study firm is projected to have a 100 percent probability of a positive annual cash flow in year one. The simulation projected the highest annual cash flow at $214,976.51, an average annual cash flow of $141,684.77, and a minimum annual cash flow of $56,507.10. The months of January, February, August, October, November, and December are projected with a 100 percent probability of a monthly cash flow above $5,000. The month of March has a 25 percent probability of a cash flow above $5,000, a74 percent probability of a cash flow between$0.00 and $5,000, and a 1 percent chance of a negative cash flow. May has a 38 percent probability of a cash flow between $0.00 and $5,000, and a 62 percent probability of a negative cash flow. July was found to have a 10 percent probability of a cash flow above $0.00 and, a 90 percent probability of a negative cash flow. April and June have a 100 percent probability for a negative cash flow as shown in Table 11. Simulation two summary statistics show that the case study firm's cash flow problems continue for the months of April, May, June, and July. The lowest expected cash flow ($17,648.75) is for the month of June as shown in Table 12.

Table 11. Simulation Two Product Lines A, B, & C
Year 1 Monthly Cash Flow and Year 1 Annual Cash Flow Projections
StopLight Chart for Probabilities Less Than $0.00 and Greater Than $5,000.00

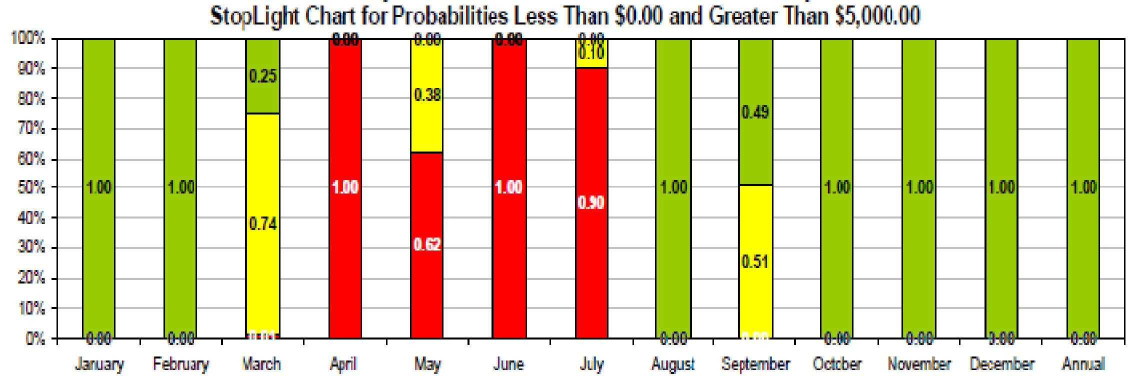


Table 12. Summary Statistics Simulation Two Monthly Cash Flows And Annual Cash Flow Year One Projections

Time Period	Mean		Min		Max	Standard Deviation
January	$	29,377.67	$	20,253.65	$	37,588.75	3346.51
February	$	33,872.40	$	22,033.99	$	44,201.11	3716.55
March	$	3,730.20	$	(1,816.95)	$	8,322.85	1746.00
April	$	(10,484.85)	$	(14,825.74)	$	(6,007.24)	1553.20
May	$	(593.77)	$	(6,599.81)	$	5,377.40	1939.93
June	$	(14,680.71)	$	(17,648.75)	$	(11,489.63)	1042.29
July	$	(2,737.25)	$	(8,522.04)	$	3,540.51	1996.09
August	$	17,279.63	$	8,670.13	$	25,026.75	2649.21
September	$	4,917.69	$	(692.91)	$	9,617.11	1814.46
October	$	19,369.73	$	10,967.73	$	26,407.08	2665.70
November	$	20,640.15	$	12,415.04	$	27,661.52	2763.25
December	$	40,993.88	$	29,389.63	$	50,656.63	3752.42
Annual	$	141,684.77	$	56,507.10	$	214,976.51	26374.24

Compared to simulation one, simulation two cash flows are improved because sales of product C during the summer months generate revenue and employ labor when product line A sales are low.

Simulation Three

Simulation three is used to simulate the monthly cash flows and year one annual cash flow for the case study firm if product lines A1, B, and C are produced, with the firm using just in time inventory. Results of this product mix out of the simulations using just in time inventory is the most promising with the highest maximum annual cash flow of $248,416.51. Simulation three also showed improvement in monthly cash flow projections and probabilities. The months of January, February, August, October, November, and December all were found to have a 100 percent probability of a cash flow of least $5,000. The Months of March and September also improved with a 100 percent probability of a positive cash flow. March was found to have an 80 percent probability of a cash flow above $5,000 and 20 percent probability of a cash flow between $0.00 and $5,000. September has a 93 percent probability of cash flow above $5,000 and only a 7 percent probability of a cash flow being lower. The months of May and July had mixed outcomes with May having an 8 percent probability of a cash flow above $5,000, a 79 percent probability of the cash flow falling between $0.00 and $5,000, and 13 percent chance of a negative cash flow. July was found to have a 49 percent probability of a cash flow between $0.00 and $5,000 and a 51 percent probability of a negative cash flow as shown in Table13. Again April and June with all simulations to this point have a 0 percent probability for a positive cash flow. The summary statistics in Table 14 show that only the months of April and June will require the firm to acquire capital to continue operation. April requiring an average capital infusion of $7,698.18 and June requires $11,894.05 to keep manufacturing operations on going. This is an improvement from simulation two which, on average, would need capital for the months of April, May, June, and July.

Table 13. Simulation Three Product Lines A1, B, & C
Year 1 Cash Flow and Year 1 Annual Cash Flow Projections
StopLight Chart for Probabilities Less Than $0.00 and Greater Than $5,000.00

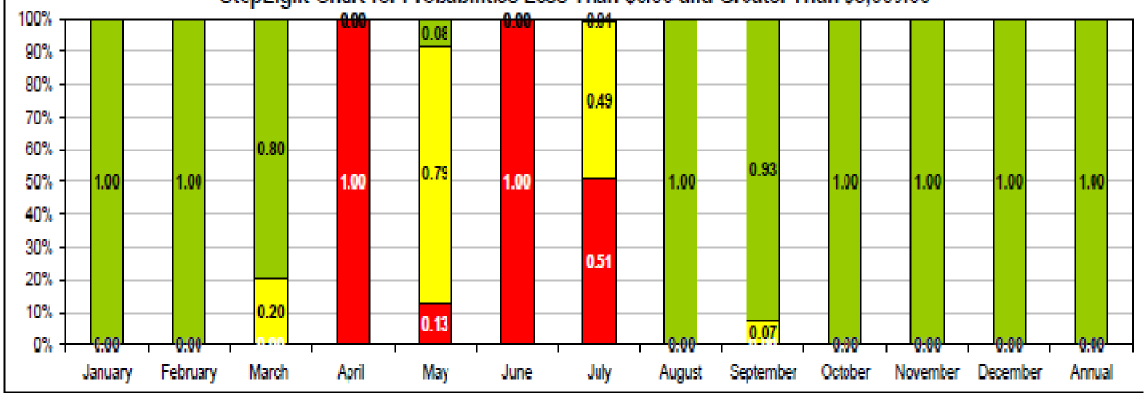


Table 14. Summary Statistics Simulation Three Monthly Cash Flows And Annual Cash Flow Year One Projections

Time Period		Mean		Min		Max	Standard Deviation
January	$	32,164.34	$	23,040.32	$	40,375.42	3346.51
February	$	36,659.06	$	24,820.65	$	46,987.77	3716.55
March	$	6,516.87	$	969.72	$	11,109.52	1746.00
April	$	(7,698.18)	$	(12,039.07)	$	(3,220.57)	1553.20
May	$	2,192.89	$	(3,813.14)	$	8,164.07	1939.93
June	$	(11,894.05)	$	(14,862.09)	$	(8,702.97)	1042.29
July	$	49.41	$	(5,735.37)	$	6,327.18	1996.09
August	$	20,066.30	$	11,456.79	$	27,813.41	2649.21
September	$	7,704.36	$	2,093.76	$	12,403.78	1814.46
October	$	22,156.40	$	13,754.40	$	29,193.75	2665.70
November	$	23,426.82	$	15,201.71	$	30,448.18	2763.25
December	$	43,780.55	$	32,176.29	$	53,443.30	3752.42
Annual	$	175,124.77	$	89,947.10	$	248,416.51	26374.24

Out of simulations one and two, simulation two shows that the case study firm has the highest potential annual cash flow when producing all of the existing product lines. Product line A is clearly the most important product line to the case study firm in making a positive yearly cash flow. The weakness of product line A is the annual sales cycle that the product follows. It leaves the firm's cash flow vulnerable form March to September as shown in Figure 4. Product line B is important to the firm during the months of March, August, September, and October as shown in Figure 5. The addition of product line C in simulation two improves the firm's cash flow position. Product C has the potential to add cash flow stability to the months of March, May, July, and September. For product line C to greatly affect cash flow of the case study firm, output and sales of C would have to be three times greater than what has been assumed. This may not be feasible in the short run but may be a position the case study firm pursues in the long run to continue to improve the cash flows for summer months.

Simulation Four

In simulation four, the monthly cash flows and year one annual cash flow for the case study firm are simulated if product lines A and B are produced. In simulation 4, it is assumed that the firm is using straight line production and is keeping an inventory of products which the firm's gross sales cannot exceed. Simulation four revealed the months of January, February, August, October, November, and December all were projected to have a 100 percent probability of a cash flow above $5,000. The months of April, May, June, and July were found to have a 0 percent probability of a positive cash flow. The month of March was found to have a 52 percent probability of a cash flow between $0.00 and $5,000 and a 47 percent chance of a negative cash flow. September has a 32 percent probability of a monthly cash flow above $5,000, a 50 percent probability of a cash flow between $0.00 and $5,000, and an 18 percent chance of a probability of a negative cash flow as shown in Table 15. The annual cash flow for simulation four was found to have a

99 percent probability of positive cash flow above $5,000 and a 1 percent chance of a negative cash flow. The lowest annual cash flow found by the simulation was ($19,125.25). When simulation four results are compared to simulation one, simulation one yields better overall cash flows and cash flow probabilities. Simulation four's summary statistics does yield three months that show the potential to have a higher cash flow then that of simulation one. These months as shown in Table 16 include October with a maximum cash flow of $40,837.01, November with a maximum cash flow of $43,925.88, and December with a maximum cash flow of $47,726.92. These cash flows can be explained by the straight line production and the standing inventory strategy the firm uses in this simulation. For these three months the firm has higher sales rates for product line A as well as a larger standing inventory of the product that were produced during the spring and summer months. This allows the firm to sell products that were paid for in earlier months. This strategy causes the firm to have lower summer cash flows than those found in simulation one.

Table 15. Simulation Four Product Lines A & B
Year One Monthly Cash Flow and Year 1 Annual Cash Flow Projections
StopLight Chart for Probabilities Less Than $0.00 and Greater Than $5,000.00

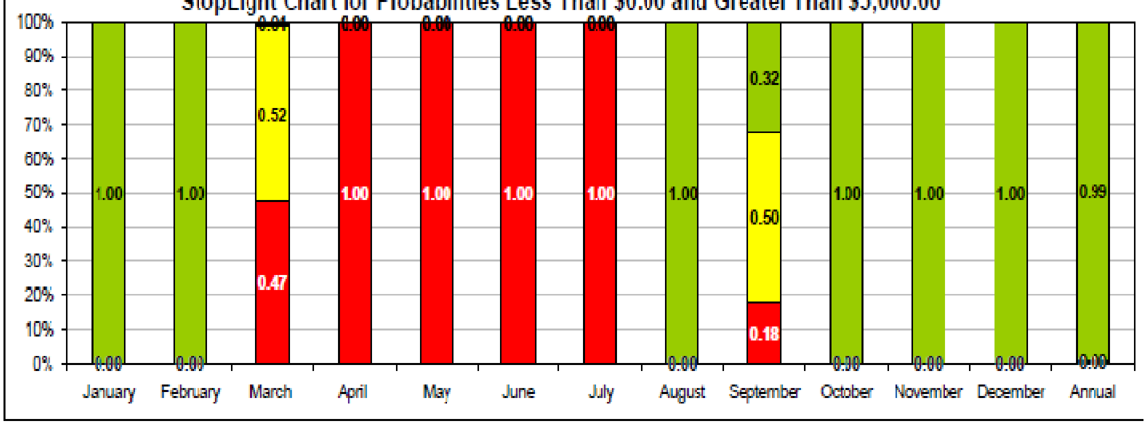


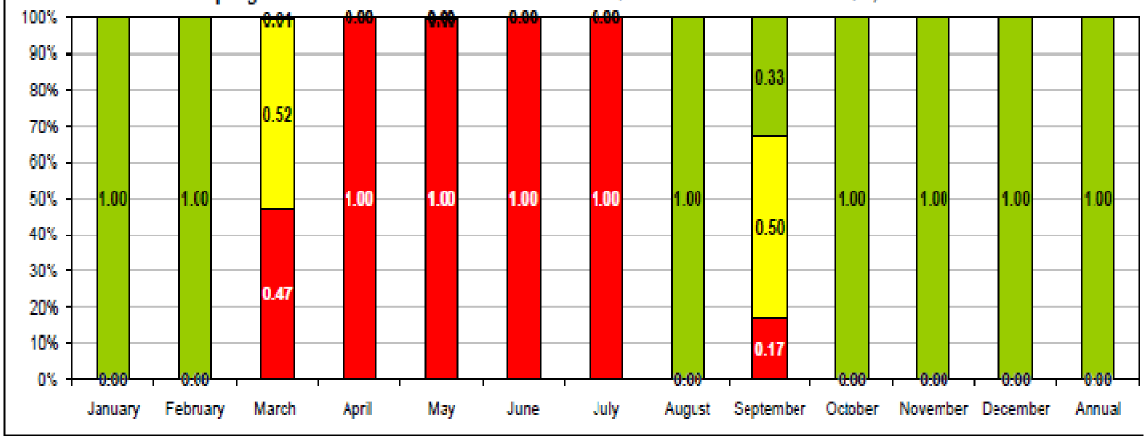
Table 16. Summary Statistics Simulation Four Monthly Cash Flows And Annual Cash Flow Year One Projections

Time Period	Mean	Min	Max	Standard Deviation
January	$ 30,421.03	$ 28,260.95	$ 32,541.75	888.83
February	$ 18,094.01	$ 8,417.86	$ 29,647.06	3953.63
March	$ (73.11)	$ (8,449.86)	$ 5,950.40	2406.54
April	$ (23,210.07)	$ (31,716.40)	$ (16,614.05)	2646.79
May	$ (11,415.76)	$ (20,416.94)	$ (3,322.40)	2955.68
June	$ (41,109.72)	$ (46,896.07)	$ (35,827.76)	1811.45
July	$ (23,243.40)	$ (30,762.83)	$ (16,847.62)	2511.06
August	$ 17,505.28	$ 6,250.25	$ 28,472.19	4044.97
September	$ 3,305.42	$ (6,727.62)	$ 12,534.86	3442.98
October	$ 27,591.31	$ 14,532.90	$ 40,837.01	4658.26
November	$ 31,483.93	$ 17,799.32	$ 43,925.88	4878.47
December	$ 47,121.37	$ 7,147.12	$ 63,365.44	11620.11
Annual	$ 76,470.29	$ (19,125.25)	$ 120,984.73	23623.41

Simulation Five

Simulation five is used to simulate the monthly cash flows and year one annual cash flow for the case study firm if product lines A, B, and C are produced. Simulation five also assumes the firm is using straight line production and keeping a standing inventory of products which the firm's gross sales cannot exceed. This simulation reveals a 100 percent probability of an annual cash flow above $5,000, with the highest annual projection of $152,683.22. The monthly cash flows for January, February, August, October, November, and December were all found to have a 100 percent probability of a cash flow above $5,000. The months of April, May, June, and July yielded a 0 percent chance of a positive cash flow. March was found to have a 53 percent probability of cash flow between $0.00 and $5,000 and a 47 percent chance of a negative cash flow. September yielded a 33 percent chance of a cash flow above $5,000, a 50 percent chance of a cash flow between $0.00 and $5,000, and a 17 percent chance of a negative cash flow. Further cash flow probability information for case study five can the found in Table 17.

Table 17. Simulation Five Product Lines A, B, & C
Year 1 Monthly Cash Flow and Year 1 Annual Cash Flow Projections
StopLight Chart for Probabilities Less Than $0.00 and Greater Than $5,000.00



The summary statistic shown in Table 18 show that the months of August, September, October, November, and December all have higher maximum cash flows the those of simulation two. The spring and summer months are again found to be lower than those of simulation two. The lowest monthly cash flow of ($34,888.02) is found for the month of June.

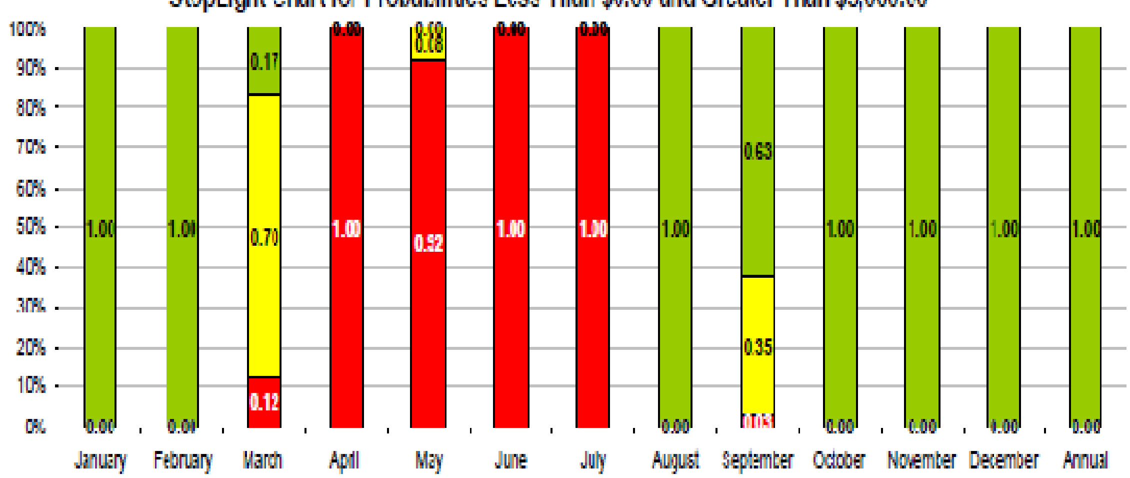
Table 18. Summary Statistics Simulation Five Monthly Cash Flows And Annual Cash Flow Year One Projections

Time Period	Mean	Min	Max	Standard Deviation
January	$ 28,330.02	$ 26,138.94	$ 30,544.63	891.11
February	$ 18,190.51	$ 8,709.84	$ 29,177.92	3936.62
March	$ 23.38	$ (9,375.51)	$ 6,100.46	2360.14
April	$ (23,113.28)	$ (31,745.75)	$ (16,018.58)	2602.02
May	$ (6,944.21)	$ (16,910.22)	$ 1,239.12	2963.88
June	$ (27,890.85)	$ (34,888.02)	$ (20,367.53)	2260.38
July	$ (13,776.70)	$ (26,950.81)	$ (4,969.69)	3458.38
August	$ 20,656.79	$ 9,235.54	$ 31,782.84	4039.46
September	$ 3,401.92	$ (7,176.11)	$ 12,179.40	3408.63
October	$ 27,687.81	$ 13,326.27	$ 39,719.29	4592.57
November	$ 29,392.92	$ 15,295.13	$ 41,321.58	4829.81
December	$ 51,592.86	$ 12,502.57	$ 68,993.43	11658.79
Annual	$ 107,551.18	$ 2,702.03	$ 152,683.22	22911.31

Simulation Six

In simulation six, the monthly cash flows and year one annual cash flow for the case study firm if product lines A1, B, and C are produced. Simulation six also assumes the firm is using straight line production and keeping an inventory of products which the firm's gross sales cannot exceed. Simulation six reveals a 100 percent probability of a cash flow above $5,000 with the highest possible annual cash flow of $186,123.22. The months of January, February, August, October, November, and December were all found to have a 100 percent of a monthly cash flow above $5,000. April, June, and July yielded 0 percent probability of a positive monthly cash flow. The months of March, May, and September were found to have mixed results. March had a 17 percent probability of a cash flow above $5,000, a 70 percent chance of a cash flow between $0.00 and $5,000, and a 12 percent chance of a negative cash flow.

Table 19. Simulation Six Product Lines A1, B, & C
Year 1 Monthly Cash Flow and Year 1 Annual Cash Flow Projections
StopLight Chart for Probabilities Less Than $0.00 and Greater Than $5,000.00



May yielded an 8 percent probability of a cash flow above $0.00 and a92 percent probability of a negative cash flow. The month of September was found to have a 63 percent probability of a cash flow above $5,000, a 36 percent probability of a cash flow between $0.00 and $5,000, and a 3 percent chance of a negative cash flow as shown in Table 19.

Summary statistics in Table 20 show that again the months of August, September, October, November, and December have higher monthly cash flows then those of simulation three. But again as all simulations' using straight line production and a standing inventory, simuation six still has a lower annual cash flow than simulation three.

Table 20. Summary Statistics Simulation Six Monthly Cash Flows And Annual Cash Flow Year One Projections

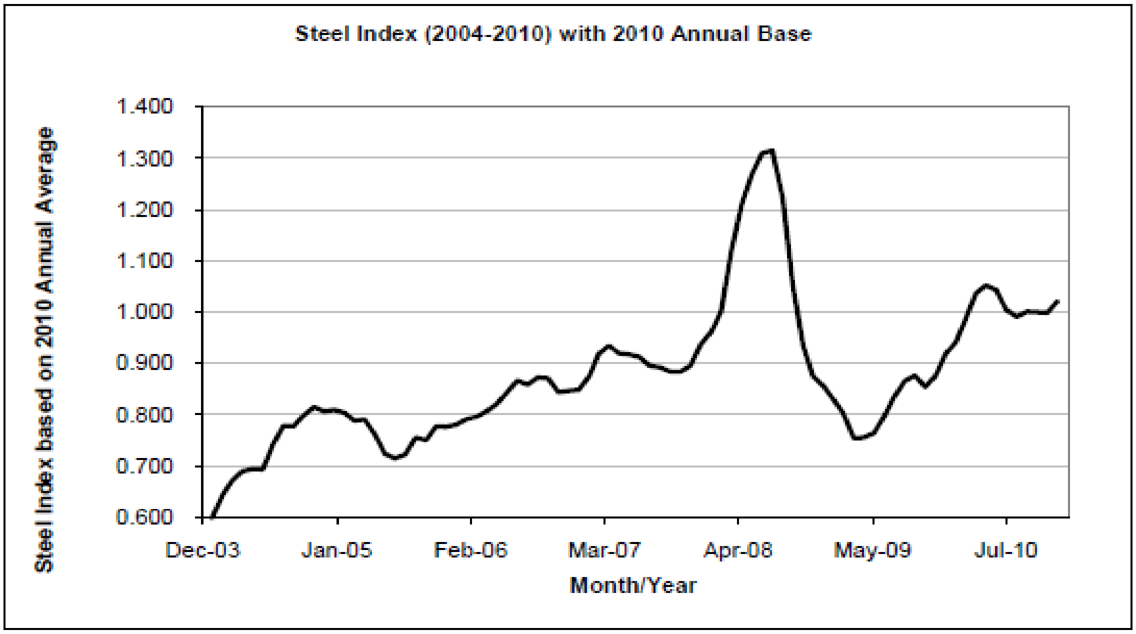
Time Period	Mean	Min	Max	Standard Deviation
January	$ 31,117.30	$ 28,925.61	$ 33,331.30	890.50
February	$ 20,977.78	$ 11,496.51	$ 31,964.59	3935.42
March	$ 2,810.66	$ (6,076.42)	$ 8,887.13	2357.88
April	$ (20,326.00)	$ (28,446.66)	$ (13,231.91)	2600.19
May	$ (4,156.93)	$ (13,611.13)	$ 4,025.79	2962.06
June	$ (25,103.57)	$ (31,588.93)	$ (17,580.86)	2258.80
July	$ (10,989.43)	$ (24,164.15)	$ (2,183.03)	3457.62
August	$ 23,444.07	$ 12,022.20	$ 34,569.50	4037.94
September	$ 6,189.19	$ (4,017.05)	$ 14,966.07	3406.87
October	$ 30,475.09	$ 16,578.71	$ 42,505.96	4590.76
November	$ 32,180.20	$ 18,454.20	$ 44,108.24	4828.18
December	$ 54,380.14	$ 15,289.24	$ 71,780.10	11658.55
Annual	$ 140,998.50	$ 42,291.10	$ 186,123.22	22880.84

Simulations One though Six all show a need for the case study firm to have readably available capital for months that may not have a positive cash flow. These months are most common in the late spring and summer. From the simulations we can also conclude that the most profitable product mix for the case study firm is that of Simulation's three and six. The product lines A1, B, and C in a product mix give the firm the highest possible annual cash flow and the least risk of a negative cash flow for all months. These simulations made several assumptions about product line A1 that should be considered by the case study firm. Since product line A1 replaces the case study firms most important product line A, caution should be taken when considering any change.

When comparing the two production strategies, (build to order use of just in-time inventory and straight line production with a standing inventory of products) the strategy of just in time inventory is found to produce much better overall results. The simulations using this strategy have a consistently high annual cash flow. The straight line production strategy does show some promise to improve the cash flow of late summer and fall months but these improvements are negated by the decrease in cash flow during early and mid summer months.

Steel price variability increases variability in cash flow. Figure 9 shows that for the last seven years steel prices have been trending upward at around 21 percent per year. It is also true that the steel prices have a seasonal price cycle for the time period between (2004-2010), that peaks during the months of June, July, August, and September as shown in Figure 7. Since these months are prone for negative cash flows due to low sales, the rise in steel prices compound the case study firm's cash flow problems, particularly when the buys steel for production during summer months when sales are low. The firm can use buying tactics to limit the negative effects of seasonal price increases of the summer months by buying steel inputs during the spring. This would help lower the case study firms overall steel input cost as well as raise the probability of a positive cash flow for the firm during the slower summer months

Figure 9. Steel Price Index



CHAPTER V

CONCLUSIONS

Small manufacturers are important to the state of Oklahoma's economy and the state of Oklahoma has taken steps to keep them competitive and retain manufacturing jobs. The state of Oklahoma is currently achieving this through the funding of state associations and centers such as the Oklahoma Manufacturing Alliance and the Oklahoma State University New Product Development Center. These organizations help manufactures stay competitive by giving advice as well with helping small manufacturers find efficient solutions to problems and issues they face. Even with the assistance from these agencies the manufacturers must still make a strategic decision to employ their advice. Many of these firms will have to make strategic decisions that will change how their company is organized or even which products they manufacture and sell. It is important to give small manufacturers a tool that will assist them in the strategic decision making process and allow manufacturers to simulate their business structure. Improved strategies will enable manufacturers to first understand their current business situation and simulate business scenarios before making a decision that may or may not lead to desirable outcomes with a higher probability of success.

The primary objective of this thesis is to design an informative analytical tool for small Oklahoma manufacturing firms that would assist in their strategic planning and decision making processes.

The specific objectives were to:

1. To determine the probability of a positive cash flow for a small Oklahoma manufacture firm under different product mixes and production practice scenarios.
2. To analyze seasonal sales variability of a small Oklahoma manufacture and determine its effect on the firms monthly cash flow given various product mixes.
3. To determine the importance of variability in prices of key inputs, primarily steel, on cash flow.

To meet these objectives the small manufacturer strategic decision making model or (SMSDM) was built by modifying and expanding on Kenkel and Holcomb's existing feasibility template, so to better fit the needs of small manufacturers. Two versions of the SMSDM were created and demonstrated: the basic version for cash flow projections and probabilities and the more advanced version used in this thesis. The advanced version uses the Excel® based program Simetar© to run scholastic simulations for monthly cash flows and gives the SMSDM the ability to calculate cash flow risk. We find that both the basic and the advance versions of the SMSDM meet the overall objective of this thesis, which was to assist small manufactures with an informative tool to aid in make strategic decisions.

The SMSDM was used to simulate production practices and product mixes of a small Oklahoma manufacturing firm. These simulations yielded information to the cash flow cycle of the firm and probability's of positive and negative cash flows. It was found that the firm's most profitable product mix of current products was a mix of product lines A, B, and C with product line A being the most important. When the new product line A1 is produced in place of product line A the probabilities of positive cash flows for several months of the year increase. If the assumption for product line A1 are found to hold true then these simulations find that product line A should be replaced with product line A1. The simulation also found that the firms had the highest potential annual cash flow when using the strategy of just in time inventory.

Product sales data for the case study firm showed that the firm has a very distinct sales pattern for product line A. The majority of sales for product line A are during the fall and winter months. Product line B had a more stable sales cycle with increases in sales during the end of spring and the beginning of fall. These sale cycles haven shown to leave the case study firm vulnerable during the summer months to negative cash flows. Product line C attempts to fill the void during these months but has not yet been capable given its limited volume it has been in production. The case study firm may need to explore other options for a summer product or think of expanding current product line sales to new markets. This thesis finds that sales variability is the largest threat to the firm's cash flow.

Variability in steel prices does increase the variability in the case study firm's cash flow. For the last seven years steel prices have been trending upward at around 21 percent per year on average. Steel prices also have a seasonal price cycle that peaks during the summer months that the case study firm is prone for negative cash flows due to low sales. This rise in steel prices during the summer months compounds the case study firm’s cash flow problems.

Further research recommended for future study should consider the inventory of parts, seasonal variation in employment, and possible alternative employment strategies. These topics are not directly addressed in this thesis but may hold important information for Oklahoma manufacturers.

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Scope and Method of Study: The propose was to design an informative analytical tool for small Oklahoma manufacturing firms that would assist in their strategic planning and decision making processes. The specific objectives were to: 1) determine the probability of a positive cash flow and profit for a small Oklahoma manufacturer under different product mixes and production practice scenarios; 2) analyze seasonal sales variability of a small Oklahoma manufacture and determine its effect on the manufacturer's monthly cash flow and profit given various product mixes; and 3) determine the importance of variability in prices of key inputs, primarily steel, on cash flow and profit. Data was obtained for a small Oklahoma manufacturer and the Bureau of Labor Statistics. The program Simetar© was used to run cash flow simulations and project cash flow probabilities for a case study.

Findings and Conclusions: An informative analytical tool for small Oklahoma manufacturers was successfully created and used to run six simulations. Cash flow projections for the case study show that the firm has a cash flow problem during summer months of the year. The negative cash flow for the summer months was found to be most directly related to variability in product sales. Steel price variability did affect cash flows negatively during the summer months also but was less of a factor than sales variability. The firm had the highest projected annual cash flows when producing one newly designed product and two of the standard products while manufacturing when products are ordered.

ADVISER'S APPROVAL: Daniel S. Tilley