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FINANCIAL IMPLICATIONS OF FACILITY DESIGN

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ABSTRACT

Sizing, staging, and timing construction of dairy facilities and improvements have significant financial implications. This is true whether planning an incremental, step-wise expansion, or a large multi-barn new dairy complex. Long-term site planning is an obvious first-step that if not completed will likely result in needless demolition, redesign, or similar avoidable expenses. Expansion capacity and flexibility is a key trait of profitable facility designs. The effective design requires considerable analysis and planning to properly stage and size the design while integrating with the investment plan in order to capture maximum capital and operating efficiencies while meeting cash flow requirements in a volatile marketing environment. Issues include sizing manure storage versus permitted animal units for the entire site, planning housing to have modest expansion capacity, parlor footprint versus initial number of stalls, locating and sizing fresh cow pens for initial startup versus steady state needs, planning feed storage and procuring feed inventories prior to animal arrival, timing animal freshening with completion of the parlor. The financial consequences these issues present include additional capital expenditures, increased interest expense, higher cull rates, larger operating line of credit, lowered productivity, and reduced parlor efficiency. If not properly managed, these can place an excessive constraint on long-term business performance.

KEYWORDS. Facility design, capital efficiency, operating efficiency, sustainable growth, economic analysis, financial risk.

INTRODUCTION

Sizing, staging, and timing construction of dairy facilities and improvements have significant financial implications. This is true whether planning an incremental, step-wise expansion, or a large multi-barn new dairy complex. Long-term site planning is an obvious first-step that if not completed will likely result in needless demolition, redesign, or similar avoidable expenses. Expansion capacity and flexibility is a key trait of profitable facility designs.

Within the industry today, there is not a formula for the optimum growth strategy. Often, builders are eager to design and construct as much facility as the owner is willing to pay for with little attention given to the profitability of the facility. Conversely, an overly cautious approach that significantly overcrowds the facility or that stages construction based on capital availability and ignores the construction implications can be equally as restrictive to long-term business performance.

The effective design requires considerable analysis and planning to properly stage and size the facilities while integrating with the investment plan in order to capture maximum capital and operating efficiencies while meeting cashflow requirements in a volatile marketing environment.

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FINANCIAL CONTEXT

The Farm Financial Standards Council (1995) identifies 16 measures of business performance. These relate to the key traits of a business – efficiency, profitability, liquidity and solvency. Of these 16 measures three, namely ROA (rate of return on assets), asset turnover ratio, and operating profit margin ratio, are particularly relevant for characterizing tradeoffs in facility design.

- The rate of return on farm assets is often used as an overall index of profitability. It is a computed as a ratio of net farm income from operations before interest and taxes divided by the average total assets employed.
- The asset turnover ratio is a measure of how efficiently the business' assets are generating revenue. It is calculated by dividing gross revenues by the average total assets employed.
- Operating profit margin ratio measures profitability in terms of return per dollar of gross revenue. It is calculated by dividing net farm income from operations before interest and taxes by gross revenue.

If the same method is used to calculate net farm income from operations before interest and taxes, gross revenues, and average total assets, then these three measures are directly related. Rate of return on farm assets equals the asset turnover ratio multiplied by the operating profit margin ratio. Restated in non-financial terms, the overall profitability of a business is a combination of how efficiently the assets generate revenue and how efficiently business operations generate returns.

In the context of evaluating facility design alternatives, the financial consequence of the decision will drive either the asset efficiency or the operating efficiency or both. Across the long term decision horizon of typical dairy business plans, it is critical to achieving the proper financial performance, which is a function of capital and cost structure (Hoekema, 1998, 1999). As such, the tradeoff in short-term planning and long-term implications is of interest to the dairy business designer.

In more practical terms, the business planning process is one of matching investment decisions to available capital while keeping constant eye on the overall business performance. The following diagram illustrates this decision path.

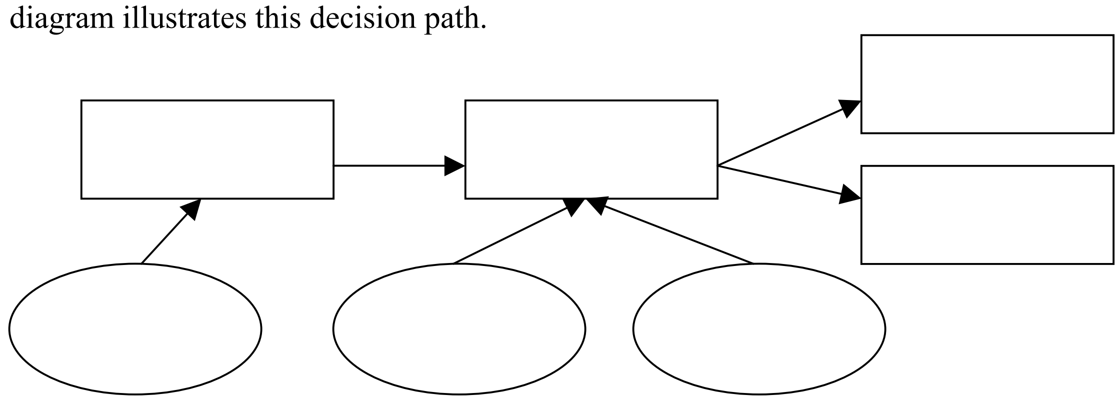

Figure 1. Capital decision path of a typical start up business.

Over time, there is an ongoing availability of capital from which investment is made. The initial capitalization of the business will drive both required growth – that growth necessary for the business to remain solvent – and planned growth which is optional relative to business viability but desired to meet the owner's investment objectives. This initial capitalization is directly affected by days to material operation and any cost overruns that might be incurred during the facility construction.

Once the facility's basic features are decided, some decisions on growth staging, sizing, and the phasing is necessary. This dynamic can be simplified into two basic premises:

- <u>Planned growth</u>: Various economic, tax, and profit objectives will suggest that growth of the business is required and necessary, and makes business sense. Planning this is easy on paper. However, various up-front changes (such as lagging days to start-up or cost over runs) will make this a big challenge from a planning and long-term profitability perspective.

- Required growth: This is a direct anti-sum of planned growth as there may be direct issues of cost over-run and start up lags which cause the business to dip into the planned growth pot or run out of available capital. If required growth is too high, it will upset the initial capitalization plan and probably have undesirable financial implications.

The reason this is important is that a capacity to grow needs to be built up-front for a healthy business plan to occur. Cost over-runs and lags will have severe, permanent financial implications on the ensuing business dynamics. As such, the design needs to be flexible and staged to allow profitable, planned growth to occur. This leaves the basic questions to either grow up-front or on the back. This leads us into questions of risks and returns, which will be a function of the flexible design alternatives and growth path.

EXAMPLE

A stochastic, Monte Carlo simulation applies probability distribution to variables of importance and, using several thousand iterations, is appropriately correlated and calculations made in the response variables. The result is that confidence intervals can be calculated and drawn on the response variables of interest. In the financial projection application, it is of specific interest to know the probabilities of attaining certain levels of profitability, on both the high and low side of the risk profile. This approach provides an objective forecast for market and credit risk and projecting of future market conditions (Gleason, 2000).

To demonstrate the short and long-term implications of the up-front implications, two sample dairy design scenarios were simulated using a stochastic simulation package over a 10-year decision horizon.

- Base condition phased: a 1,500 cow dairy which grows moderately to 1,700 cows, then expands in year 4 to 2,000 then grows moderately to 2,150.
- Large scale: a 2,000 cow dairy which grows moderately to 2,150.

The above scenarios were designed to see the implication of giving consideration to a 'flex-design' in the capital budgets, while allowing for moderate growth after the initial sizes are met. If there is an advantage to be realized with the immediate scale of 2,000 cows, then the expectation that the large design up front will be more beneficial. If there is any advantage to an up-front phasing with a 'flex-design', some up-front 'extra costs' in design, may pay off with a more favorable risk profile.

Table 1 lists comparatively the initial capitalization for the various scenarios. As shown, the large-scale scenario has a higher paid-in-capital requirement, which is usually a reality for the large-scale design. Key features in the phased 'flex' scenario are as follows:

- Oversized parlor building and holding-pen.
- Oversized nutrient management facilities and equipment
- Scalable milking facility (double 24 parlor expandable to a double 30).

No special needs facility initially, but constructed in year 4.These key features resulted in a slight disadvantage to the phased 'flex' scenario (total assets per cow $214 greater for the flex design). Otherwise, the capital structure was identical with similar proportions of financing (0.60 debt to asset ratio). Similar revenue, expense, and debt structure assumptions were used for both scenarios.

In the stochastic environment, probability distributions were used to assign variation to variables of interest. Other input assumptions are listed in Table 2. Key stochastic variables were used as follows:

Table 1. Initial sources and uses statement by scenario.

	Phased 'flex' scenario	Large Scale		Phased 'flex' scenario	Large Scale
Sources			**Uses**		
Paid in Capital – Requirement	2,793,587	3,553,178	Machinery and Equipment	1,440,767	1,533,494
Machinery and Equipment note	1,440,767	1,533,494	Building and Improvements	2,441,700	3,377,950
Buildings and Improvements - Lease	2,441,700	3,377,950	Real Estate	160,000	180,000
Revolving Livestock note - replacements	Varies	Varies	Livestock	2,550,000	3,400,000
Operating note - revolving LOC	Varies	Varies	Other Assets owned	350,000	350,000
Initial livestock note	307,913	418,322	Startup inventories owned	41,500	41,500
Total	6,983,967	8,882,944	Total	6,983,967	8,882,944
			Total per cow	4,655.98	4,441.47
Total borrowings	4,190,380	5,329,767			
Total Paid-in-capital	2,793,587	3,553,178			
Initial debt to asset ratio	60%	60%			

- A distribution with expected value of 3.0% (see Figure 2) was used for a monthly herd cull rate.
- A stochastic, truncated triangular distribution with expected value of $1,818 was used for the per-head market price for heifer replacements.
- Milk sold per cow calculations were based on the effective and wet average productivity estimates. This was generated by projecting productivity and using a days-in milk model to generate annual milk sold per cow.
- A stochastic variable using a truncated, triangular distribution based on the days in milk model was used to project milk sold per cow for the pro forma projections.
- A truncated distribution for milk price with expected value $12.53 per cwt. was used for the 10-year decision horizon.
- For purchased feed expense, a distribution was correlated on dry-matter intake and days-in-milk assumptions as specified on the input sheets. This changed across the decision horizon as per cow productivity is projected to increase from year 1 conditions.

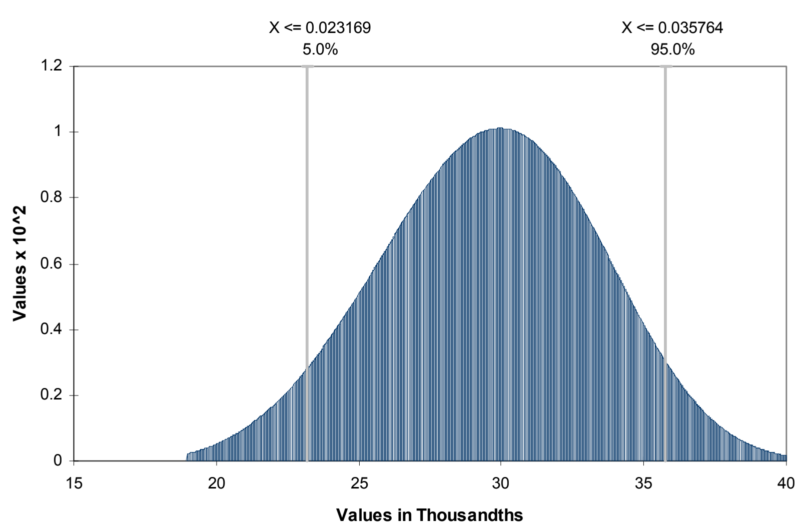

Figure 2. Monthly Cull rate distribution

Table 2. Input values for year 1 by scenario.

	'Flex' scenario	Large scenario
Herd Size	1,406	1,740
Milk Price (S)	12.53	12.53
Annual milk sold per cow (S)	22,630	22,630
Cull rate monthly (S)	3.0%	3.0%
Cull rate (annual)	35.5%	35.5%
Cull Cow price	400.00	400.00
Calf sales (per head) (S)	191.06	191.06
FTE's	24.00	29.00
Labor expense per FTE	30,168	30,168
Purchased feed expense (dollars per cow) (S)	972	972
Replacement price (per head) (S)	1,818	1,818
Milk Marketing (per cwt. milk sold)	0.20	0.20
Livestock expense (dollars per cow)	283.00	283.00
Value of mature cow (dollars per head)	1,500	1,500
Value of young stock (dollars per head)	850	850
Real Estate expenses	50,000	50,000
Interest rate-operating note	0.09	0.09
Other livestock revenues	-	-
Crop revenues	155,638	155,638
Other revenues	25,000	25,000
Total crop expenses	175,000	175,000
Total machinery expenses	80,000	80,000
Total other expenses	155,000	155,000
Dry period (days)	60	60
Realized Days in Milk (S)	360	360
Target Days in Milk	360	360
Calving interval (months)	14.00	14.00

While several variables can be followed in the pro-forma financial statement projections, the results here will be limited to performance factors that demonstrate the key dynamics of the phasing system. Figures 3 and 4 list the rate of return on equity for each scenario. These charts represent the confidence intervals around the mean (or average) for each year in order to understand the variation around the performance. The line in the center of the figure is the mean value by year. The first band is one standard deviation around the observation. The second bands are the upper and lower 5^{th} percentiles of observation, which in total represent the 90% confidence interval of the observations.

What we can see by comparing the charts, there are some key differences in the likely outcomes of the two scenarios. First, both scenarios start out with similar start-up challenges, with a negative rate of return on equity likely more than half of the time in year one. However, the 'flex' scenario out paces the 'large' scenario, posting an average of 4.4 percentage points higher ROE in year two. More importantly, the downside risk is much lower for the flex scenario and the upside potential is much higher as well. These relationships continue through year 4, when the 'large' scenario finally catches up to the flex scenario, then will have higher upside potential for the remainder of the decision horizon.

This suggests some broad differences in planning for the risk of the scenarios, particularly when considering the amount of capital at risk in these scenarios ($2.79 and $3.55 million initial paid in capital for the flex and large scenarios respectively). The reason the 'flex' scenario outperforms (both from an up-side and down-side risk perspective) is that returns are allowed to accumulate up-front (with a slightly lower total debt level) and then profitably reinvested in slight expansion in phases throughout the 4 years. The ending herd size is the same at the end for both scenarios. By cutting back some of the herd size in the initial investment, profits can accrue and returns realized at a higher percentage and with lower risk. While moderate expansion is also allowed for the 'large' scenario, the size also generates substantial downside risk in the first 3 years of operation.

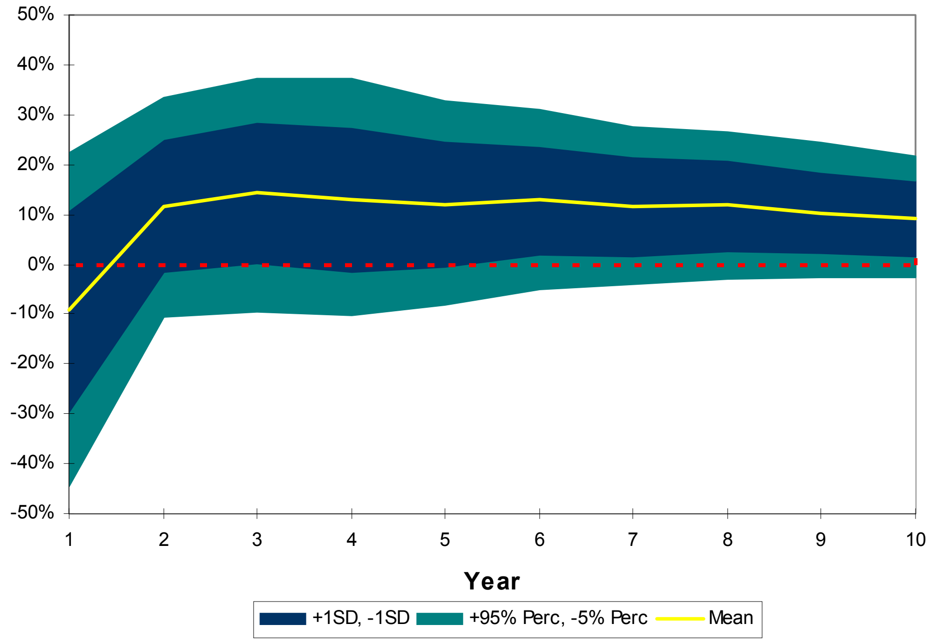

Figure 3. Projected rate of return on equity for 'flex' scenario by year.

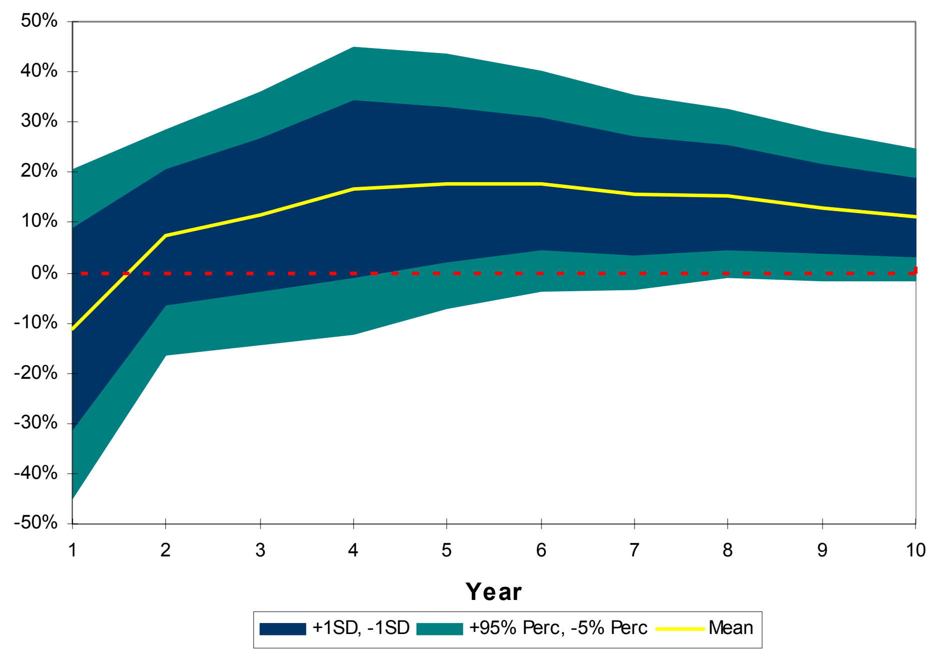

Figure 4. Rate of return on equity for 'large' scenario by year.

IMPLICATIONS

For normal dairy design work, the implications of 'flex' designs are numerous as they have to be integrated back to the physical facilities and often the constraints of the individual site. However, if this is realized up front in the planning process, it is possible to 'build' this into the design up front and have the flexibility to exercise these 'flex-options' as they become profitable and risk rewarding to execute for the dairy business manager.

There are several tenants of economic and business management theory which support the 'flex-design' approach:

- Sustainable growth theory (Higgins, 1995) suggests that managing the line between cash surpluses and shortfalls in the financial plan are of utmost importance when growing the business. Unfortunately, this theory has not had wide application to agricultural businesses

(Hoekema, 2001), primarily due to the predominant focus on tax liability management and exploitation of tax shields (Carman, 1997). This may increase with recent changes in tax laws that encourage new and reinvestment, perhaps at a penalty to long-term capital growth.

- Progressive option theory indicates that the manager will craft a decision process which allows investment into options for long-term growth. 'Cultivating' this field of options so that exercise will control risk (lower variation) and lead to positive net present value of cash flows (positive time value) increases the competitiveness of the business, allows for long-term flexibility, and provides for quantitatively directing the decision process (Leuhrman, 1998). The flex design supports this theory, which allows for basic 'insurance' to be purchased on the right (and option) to execute growth should the market conditions favor, or postpone until it becomes such.
- The dairy business is no stranger to risk and volatility. A key to prudent production agriculture business planning and profitability is flexibility in financial structure (Makeham and Malcom, 1998). Understanding the risk preference and matching the investment performance is critical in designing the new and ongoing dairy business, so that volatility can be managed and risk controlled (Hoekema, 2001).

As such, if the plan does not have growth and flexibility as part of its inherent design, the plan contradicts several key business management and economic concepts of risk management, portfolio, and growth theories.

DESIGN ALTERNATIVES

In recent years there have probably been as many combinations of facility growth strategies as facilities constructed. Our intent is not to evaluate the merits of each approach but rather to frame the financial context and provide a methodology for evaluating alternatives. However, it is nonetheless constructive to provide a minimal characterization of the most common growth strategies.

Design considerations for the 'flex design' should include the number of barns, timing of special needs barn construction, milking center sizing (i.e. number of working stalls), milking center building sizing, and placement of buildings so that the facilities can be flexed out should the option be exercised. These options are easily scalable and represent considerable risk management and financial advantages to the business plan.

The reason the sizing and phasing issues are critical to get correct up-front is that they have substantive long-term implications on the profitability, efficiency, liquidity, and solvency of the business. If it is not set up correctly up-front, either long-term flexibility is diminished, or a worse effect is that the business financial sustainability and survival is threatened or jeopardized. Table 3 lists common dairy facility options with their corresponding financial implications. The magnitude and impact will of course vary by design and materiality. However, the concept to realize is that there are trade-off's between up front size and long-term capital and operating efficiencies. The optimal facility will balance long term efficiencies with the capital availability and the design requirement of the site.

Issues include sizing manure storage versus permitted animal units for the entire site, planning housing to have modest expansion capacity, parlor footprint versus initial number of stalls, locating and sizing fresh cow pens for initial startup versus steady state needs, planning feed storage and procuring feed inventories prior to animal arrival, timing animal freshening with completion of the parlor. The financial consequences these issues present include additional capital expenditures, increased interest expense, higher cull rates, larger operating line of credit, lowered productivity, and reduced parlor efficiency. If not properly managed, these can place an excessive constraint on long-term business performance.

Table 3. Common facility options and financial implications.

Decision	Capitalization Magnitude		Impact on Efficiency	
	Initial	Total	Capital Efficiency	Operating Efficiency
MANURE STORAGE				
Initial construction for maximum planned requirements	+++	Neutral	↓	↑
Sized to current capacity	Neutral	++	Neutral	Neutral
Minimal construction until final animal numbers reached	--	+	↑	↓↓
PARLOR				
Initial construction for maximum planned requirements	+++	Neutral	↓↓	↓↓
Initial footprint for maximum planned requirements	++	Neutral	↓	↓
Sized to current capacity	Neutral	+++	Neutral	Neutral
FREE STALL BARN				
Initial construction for maximum planned requirements	+++	+++	↓↓	Neutral to ↑
Sized to current capacity	++	++	↑↑	↑
Minimal construction until final animals are reached	++	++	↑↑	Neutral to↓

CONCLUSIONS

The size and flexibility of the initial capitalization in a dairy design is one of the most critical factors when designing new dairy facilities. In addition to paying high attention to cost over runs and time lags in construction, designing facilities with flex characteristics, even with a slight investment disadvantage; will enable higher returns and lower risk for the resulting business. The flexibility in design is one of the key traits that prudent and risk controlling business planners and investors will look for and when designing new facilities since growth will always be necessary and desirable from a financial planning perspective. There are clear economic and profitability advantages to adding these traits to dairy business and facility plans.

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