Using Existing Facilities in a Dairy Expansion

Brian J. Holmes
Professor and Extension Specialist
Biological Systems Engineering Department
University of Wisconsin-Madison
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Dairy producers who decide to expand herd size must control costs of new facilities to be profitable. One alternative to control costs is to convert existing structures to uses which are compatible with the expanding herd size as well as the herd size which will be achieved in the longer term. Care must be taken to achieve a cost-effective facility when remodeling. In many cases, remodeling costs are not lower than the cost of a new facility, and/or operating costs are higher. Planning can help to avoid excessively high costs for expanded facilities. One planning process which can be used to avoid excessive costs uses the following steps.

1. Establish the facilities needs for the 10-20 year horizon.
2. Establish the facilities needs for the transition to that future.
3. Evaluate the existing structures to determine how well they can be used to meet the transition and future needs.
4. Compare the initial and annual costs of a remodeled vs. a new facility.

Many options exist at the beginning of an expansion. As decisions are made, the number of options diminish. Using these four steps in the planning process will help to increase the probability of successfully selecting the better options.

Establish Future Needs

In this step of the process, a person must decouple from "what is" to consider "what could be". Numerous producers have said, "I will never get any bigger than this." When they are revisited in 10-20 years, however, they very often have increased their operation size considerably from when they made that statement. The probability of future expansion is very real. Plans for expansion should be made at the beginning so new facilities do not interfere with future facilities.

This first step should produce a business and facilities plan which establishes how the operation will look and perform in the future. You are not necessarily committing to implement the plan at this time, but you are allowing for the plan to be implemented. You are also establishing the likely route that will be traveled to reach your goals. The plan should reserve space for the future facilities.

A farmstead drawing should be developed to show all structures needed at this 10- to 20-year mark in the future. All of the concepts of farmstead planning should be used to establish the locations of these structures. These concepts promote labor savings, good natural ventilation, good surface drainage, convenient materials handling, and space for future expansion. In the past, a rule of thumb was to plan for a size four times larger than the current expansion step. This "rule" may no longer be valid as we see people who expand from 100 cows to 200 cows in a first step actually expanding again to 600-1000 cows in a relatively short time. An 800-cow operation requires significantly more facilities than a 100-cow size. This phase of the planning process may show that you need to move to a different farmstead site to obtain enough space of proper slope and elevation to implement your long-term plan. Recognizing this early in the planning process helps to avoid over-investment at the current farmstead.

Certain facilities often are over-valued when considering them for future use. These facilities may cause a dairyman to be overly attracted to expand at an existing farmstead. As an operation expands past a doubling of current size, the current facilities become less significant when satisfying future needs. A

manure storage often becomes an "anchor" for promoting expansion near the current farmstead. Much money was invested in the storage, and it is very functional. Table 1 shows how a manure storage that is adequate for a 50-cow herd storing manure for either 12 or 6 months can store manure for much shorter time periods as herd size increases beyond 100 cows. Other types of facilities such as feed storage, animal housing, bulk tanks, etc. show similar losses of significance as herd size increases.

Table 1. Effect of increasing herd size on manure storage period.

Herd Size (cows)	**Manure Storage Period** (months)	(months)
50 (initially)	12.0	6.00
100	6.0	3.00
150	4.0	2.00
200	3.0	1.50
300	2.0	1.00
400	1.5	0.75
500	1.2	0.60

Establish the Transition Needs

Before you make the move to begin the transition to a larger operation, you must determine what the facility needs will be at each of the milestones of your journey. The housing needs for all groups of animals must be established for each size of operation. Kammel et al. (1989) state that the housing system for animals should: 1) increase animal performance, 2) improve the animal environment, 3) improve management, and 4) be economical. Forage and grain storages must be sized and located. Manure storage is costly. When and how you install manure storage can greatly impact the bottom line and affect the implementation of future plans. With increased animal numbers, the ability to milk cows more effectively will become apparent. Table 2 shows what can be accomplished when recommended milking practices are used and there is no waiting for groups of cows to be switched into a holding area. Even though it is mathematically possible to milk 275 cows in a stall barn, most dairymen never achieve that upper limit. Switching cows through a smaller stall barn or significant investment in a 275-stall barn, as well as the physical effort to milk that way, cause most people to look at alternative milking systems when the herd size exceeds 100 cows. Those who push herd size to 200 cows in a stall barn milking set-up become desperate for improved milking efficiency.

Throughout the transition phase, one must establish where cows will be housed and milked and how they will move between those areas. The stall barn offers existing milking capability and a milkhouse. These are relatively expensive facilities to replace. Frequently they are continued in use as a milking area. The difficult questions then become:

1. Do I "switch milk" in the barn and use the barn to house cows when not milking?
2. Do I convert the barn to flat barn milking and house the cows elsewhere?
3. Do I convert the barn to a pit parlor and house the cows elsewhere?

The rate at which you are approaching the future plan and an analysis of your financial situation can help shed some light on this decision. A rapid move to the future with milking continuing on the current farmstead and a stall barn in good structural condition warrants consideration of a conversion of the stall barn to a pit parlor. A more gradual expansion and/or future milking occurring at a different location suggests conversion of the stall barn to a low cost ($10,000-20,000) flat barn parlor. The early phases of an expansion, where capital and income may be limiting, encourages switch milking with investment for cows and housing being the first step.

Table 2. Capacities of typical milking facilities.

Milking Facility	Approx. Through-put for One Milker (cows/hr)	Maximum Herd Size[†]	
		2x	3x
Stall barn	25	275	175
D-4 flat barn with automatic take-off & crowd gate	45	495	315
D-8 herringbone conventional parlor with automatic take-off & crowd gate or wwing 10-12 parlor	70	770	490
D-10 herringbone conventional parlor with automatic take-off and crowd gate or swing 14-16 parlor	72	790	505

[†] Number of milking animals. One-hour clean up and set up for each milking, continuous milking. No waiting for cow groups to enter holding area.

Whatever your situation, you need to establish those transition facility needs before considering the third step of evaluating existing structures and how they fit in to the long term plan. There may be several viable scenarios at this stage of the process. Each of those scenarios should have a facilities needs listing associated with them.

In the case of a stall barn converstion, one must decide amongst many possible uses of the structure which could include cow milking, animal housing, feed storage, equipment storage, etc. With all of these needs and choices, the decision can be difficult at times. Some other choices are more obvious. For example, it will probably be impossible to effectively convert a 2-row stall barn into a 4-row drive-through freestall barn using natural ventilation. The building size and construction techniques preclude this kind of conversion. On the other hand, a single-story barn with no interior supports may convert easily into a pit parlor/holding area for milking cows. If the barn is in a preferred location for a parlor, this conversion may offer a lower cost structure in which to locate the parlor. Kammel et al. (1989) state:

> The use of the building, however, should be carefully looked at to determine if it can perform in the required capacity that is intended. The benefits associated with the capital investment should match the long term goals of the operation and not just the short term need. Limiting factors in the remodeled facility may not provide for the environment that is required for an efficient production system. Physical constraints of space and/or location of a remodeled building may limit the ability to use current and new technology without major changes.

Evaluate Existing Facilities

Many factors must be considered when deciding if an existing structure can be remodeled for a different use. Kammel et al. (1989) address the issues of functional planning and structural factors when they write:

> **Functional Planning**
> Upgrading the building to provide a useful life of 20 years should be considered in the analysis of remodeling. The functionality of the building should be analyzed as it relates to the goals of the housing system that is desired. Consider the layout and expandability of the building. The size and space of the building should be analyzed to determine if it will be functional in the desired housing system. There may be limitations in the use of the space. Interior posts may limit the use of some areas of the building. The use of gates allows

flexibility in the use of space. Windows, doors, posts and framing members may have to be replaced or moved to allow better utilization of the space. Clear span post frame buildings may provide better space utilization and layout. Ventilation of the building should be considered. In some cases, it may not be possible to ventilate the building properly for the animals housed. Feeding and manure handling in remodeled buildings may be inconvenient, increase labor, and limit managability. Natural ventilation may not perform adequately, especially in two-story barns.

Structural Factors

The structural soundness of the building is an important factor in the decision to remodel. The condition of the foundation, rafters, floor joists, walls, and roof should be reviewed. Major problems in these areas may make remodeling impractical. All these areas can be major costs if extensive structural repair is required to make the buildings safe and usable.

Foundation

The foundation should be checked for cracks, heaving and leaning. Frost action on the building foundation that has not been used for several years can cause heaving and cracks. Uneven settlement or leaning foundations indicate that the foundation will need repair before it can be used. The building may need to be jacked up and footings replaced. Replacement of interior posts in two-story construction may be required to make the space usable.

Structural Frame

The frame should be checked for plumb and straightened if necessary. Determine load bearing walls and design them properly if door openings are made. Replacement of the support struc-ture or the roof may be a major expense. Symptoms of inadequate support include a sagging roof or a spongy feeling in the floor. Interior post foundations should be raised onto concrete pillars or protected in some way to prevent damage during manure removal and keep them out of the manure pack to prevent rot. Broken trusses or rafters indicate that they may be inade-quate for the loads carried. Rot in rafters and/or sills require replacement of those members.

Roofing and Siding

The wall liner and insulation level should be determined. The roof should be checked for leaks and rain damage. New siding may be required to make the building weather resistant and prevent further water damage.

Utilities

Rewiring and replumbing may also be needed since the service size and water supply may be inadequate for the intended use. Underground plumbing may be needed to prevent freezing.

Rewiring can get the electical system up to code by installing moisture and dust resistant equipment, adequate wire sizing and equipotential planes. These improvements have the benefit of reducing fire potential and increasing operator and animal safety.

Table 3 lists some factors and provides a ranking scheme to help decide if it is possible to use an existing structure for a particular purpose. The best way to use the ranking system is to sketch the building layout you would like. Use planning references (see reference list) to help establish space requirements and relationships to make sure you have a workable plan. Identify what must be removed (demolition), what support structures must be moved, and what must be added to implement the layout. Then complete the ranking scheme of Table 3. You must be very critical with each item to get an objective, average ranking. The probability of obtaining a top ranking of 5 is pretty small. Such a ranking suggests you could obtain the same facility by remodeling as by building a new one. If you obtain an average 4 to 5 ranking, you must ask yourself if you are that lucky to have the near-perfect building for remodeling or if you have not been sufficiently objective and are deceiving yourself. An average ranking of 1 or 2 should lead you to find a more appropriate alternative use for the building or simply abandon the building.

Table 3. Evaluation criteria.

Rank: 1 = major compromise; 5 = easily meets criteria; NA = not applicable.

Importance: 1 = low importance; 5 = very important.

Building Name: _____

Building Alternative Use: _____

Criteria	Importance	Rank	Imp. x Rank	Notes
Animal Needs				
Resting space	_____	_____	_____	
Walking area	_____	_____	_____	
Watering location/space	_____	_____	_____	
Feed bunk space	_____	_____	_____	
Holding area space/arrangement	_____	_____	_____	
Low travel distance	_____	_____	_____	
Good ventilation	_____	_____	_____	
Low disease transmission	_____	_____	_____	
Structure				
Sound strength -- foundation	_____	_____	_____	
Sound strength -- walls	_____	_____	_____	
Sound strength -- roof	_____	_____	_____	
Use existing floor	_____	_____	_____	
Walls and posts remain	_____	_____	_____	
Wall siding remains	_____	_____	_____	
Second floor remains	_____	_____	_____	
No excavation needed	_____	_____	_____	
Roof remains	_____	_____	_____	
Adequate insulation	_____	_____	_____	
No room divider walls needed	_____	_____	_____	(cont.)

Table 3 continued.

Criteria	Importance	Rank	Imp. x Rank	Notes
Utilities Available, Convenient, Safe, Maintenance Free and Need Not be Replaced in the Short Term				
Water	_____	_____	_____	
Hot water	_____	_____	_____	
Heat	_____	_____	_____	
Vacuum	_____	_____	_____	
Milkline	_____	_____	_____	
Manure handling	_____	_____	_____	
Feed handling	_____	_____	_____	
Feed storage	_____	_____	_____	
Milking center waste handling	_____	_____	_____	
Electricity	_____	_____	_____	
Fences, gates, stalls	_____	_____	_____	
Bedding storage	_____	_____	_____	
Bedding handling	_____	_____	_____	
Sewer/drains	_____	_____	_____	
Environment				
Protects surface water	_____	_____	_____	
Protects ground water	_____	_____	_____	
Protects air quality	_____	_____	_____	
Good surface drainage	_____	_____	_____	
Satisfies Space Need				
Meets the need of whole herd in transition	_____	_____	_____	
Meets the need of whole herd in future	_____	_____	_____	
Location -- Operator				
Convenient for frequent observation	_____	_____	_____	
Short animal movement distance	_____	_____	_____	
Annual Costs				
Low utility costs	_____	_____	_____	
Low labor costs	_____	_____	_____	
Low bedding costs	_____	_____	_____	
Low equipment cost	_____	_____	_____	
Low structure maintenance cost	_____	_____	_____	
TOTAL		_____	_____	
Number Ranked		_____	_____	
Average[†]		_____	_____	

[†] See Table 4 for decision evaluation.

Some factors should have more importance than others. You can add importance weighting factors to the ranking scheme of Table 3 by multiplying the importance factor times the rank. The product of the importance factor times the rank yields a third column which is a weighted ranking. The average weighted rank is the sum of those weighted ranks divided by the number of weighted ranks used. While this method requires more effort, the results are more reliable than just using the ranking method alone. Table 4 helps to establish an equivalency between the ranking and weighted ranking systems.

Table 4. Decision evaluation equivalencies of ranking methods.

Aver. Rank	Aver. Weighted Rank	Evaluation
1	1-5	Does not satisfy needs.
2	6-10	Not likely to satisfy needs.
3	11-15	Might satisfy needs. Compare cost to a new structure.
4	16-20	Could satisfy needs. Compare cost to a new structure.
5	21-25	Very likely to satisfy needs. Compare cost to a new structure.

Figures 1-5 show several uses for a 50-cow stall barn which measures 35' × 118' inside dimensions. These are only examples that appear to fit within the space and amongst the support posts. Other options can be developed which may also be adequate. When designing remodeled facilities, care must be taken to provide adequate space to meet the animal needs for resting, eating and movement. A special effort must be made to assure good ventilation for livestock facilities to assure good animal health and comfort.

Compare Initial and Annual Costs

Once you decide a remodel plan will provide a reasonable new use of an existing building, it is time to do partial budgets to help compare the cost of new vs. remodel costs. The decision to remodel vs. build new should be made when the costs of remodeling are less than the cost of a new structure. The cost comparison should not be limited only to initial cost but should also consider annual costs as well. For example, a remodeling project may have a lower initial cost than a new structure. However, constraints/compromises made in the design may cause labor, electricity, bedding or veterinary, etc. costs to be higher for the remodel project vs. the new construction. These compromises could reduce animal productivity or contribute to higher death loss or involuntary culling. These higher annual costs may quickly use up the savings attained initially by remodeling.

Table 5 provides a format for an initial and annual cost comparison between a remodel vs. new construction project. It is important to include all the costs needed to complete the projects and operate the facilities. A reasonable estimate of these costs is better than leaving a value out. Some producers will do some of the work themselves and assign a zero value to their effort. This is a form of false accounting because their labor has a value. If an operator is doing demolition work, what could he/she be doing with that time within the business which would make as much if not more money? If the demolition is being done totally in one's spare time or by unpaid family labor, then perhaps it could be valued as zero.

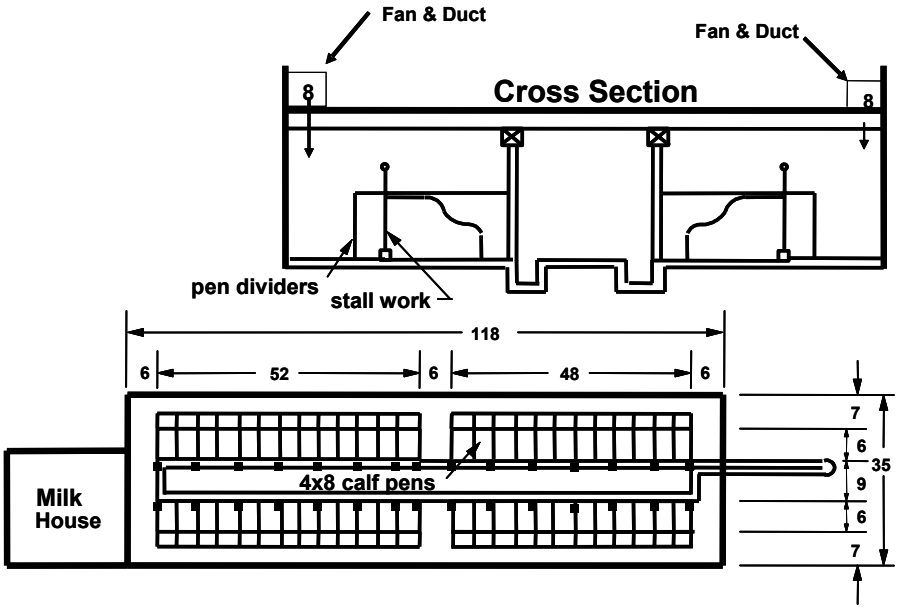

Figure 1. 50 Stall Calf Barn

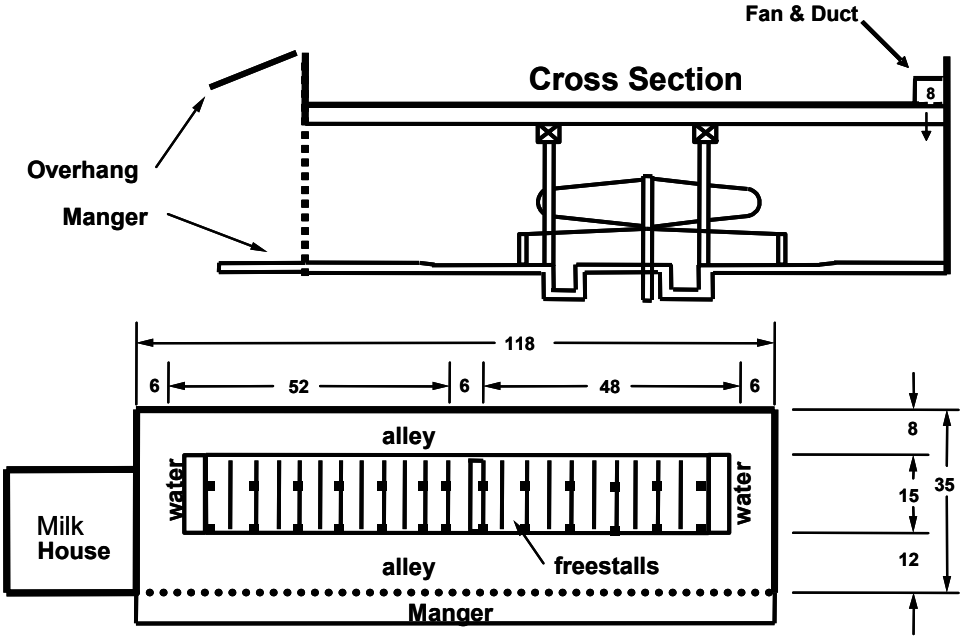

Figure 2. 44 Freestall Barn

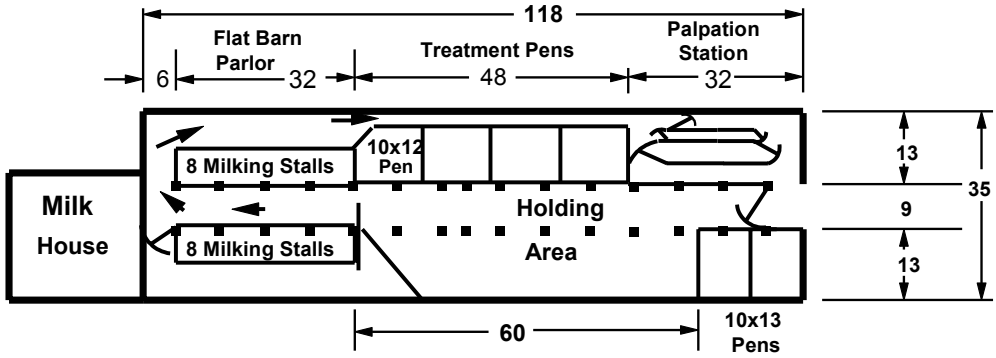

Figure 3. FLAT BARN PARLOR

Treatment Pens for 300 Cow Herd

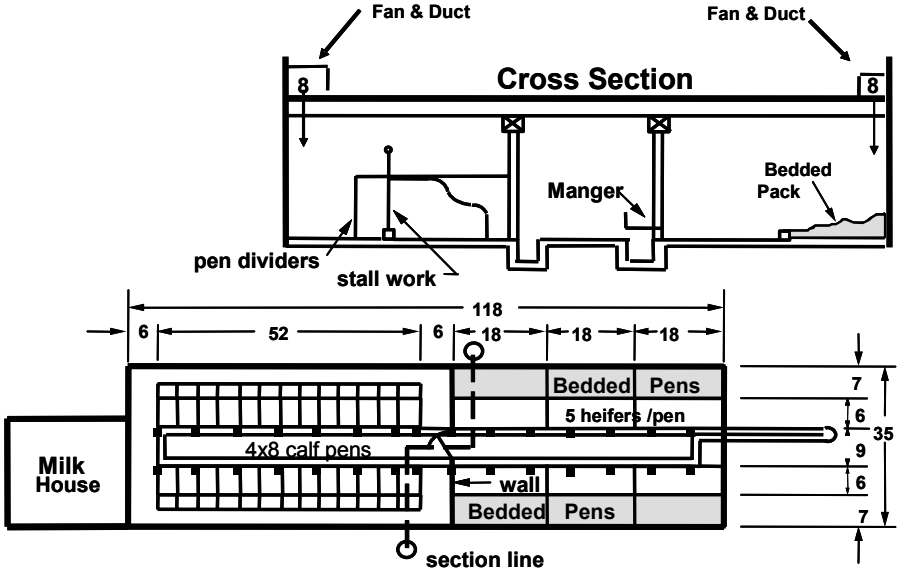

Figure 4. 26 Calf Pens with Group Pens
200 Cow Herd

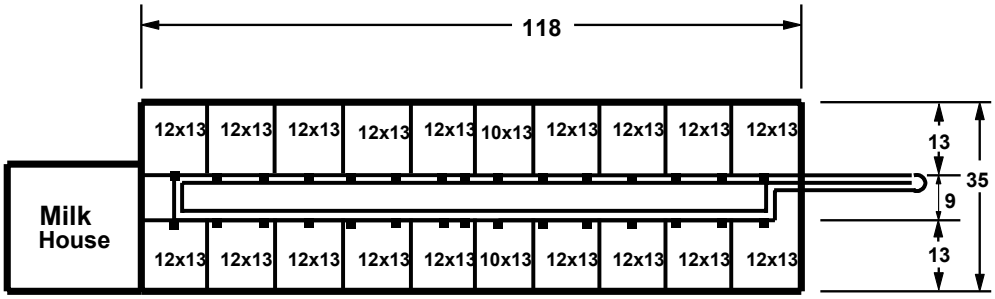

Figure 5. Maternity/Treatment Barn

300 Cow Herd

Table 5. Partial budget for building remodel vs. new construction.

	Remodel		**New Construction**	
	Initial Cost ($)	**Annual Cost** ($/yr)	**Initial Cost** ($)	**Annual Cost** ($/yr)
A. Preparing for construction, including labor				
1. Remove existing building/materials	_____		_____	
2. Site preparation	_____		_____	
3. Structural repair	_____		_____	
4. Appearance repair	_____		_____	
5. Land	_____		_____	
6. Other	_____		_____	
SUBTOTAL	_____	_____	_____	_____
B. Construction, including labor				
1. Building				
a. Floor/concrete	_____		_____	
b. Wall/ceiling/roof	_____		_____	
c. Outside yard	_____		_____	
d. Manure storage	_____		_____	
e. Equipotential plane	_____		_____	
f. Other	_____		_____	
SUBTOTAL	_____	_____	_____	_____
B. 2. Equipment				
a. Fences/gates	_____		_____	
b. Stalls	_____		_____	
c. Manure handling	_____		_____	
d. Ventilation/wiring	_____		_____	
e. Lights/wiring	_____		_____	
f. Water/plumbing/wiring	_____		_____	
g. Feeding equip./wiring	_____		_____	
h. Service entrance wiring	_____		_____	
i. Milking equip./wiring	_____		_____	
j. Other	_____		_____	
SUBTOTAL	_____	_____	_____	_____

(cont.)

Table 5 continued.

	Remodel		New Construction	
	Initial Cost ($)	**Annual Cost** ($/yr)	**Initial Cost** ($)	**Annual Cost** ($/yr)
C. Operating Cost				
1. Electricity/fuel		_____		_____
2. Bedding		_____		_____
3. Labor		_____		_____
a. Feeding		_____		_____
b. Bedding		_____		_____
c. Animal handling		_____		_____
d. Watering		_____		_____
e. Cleaning		_____		_____
4. Veterinary		_____		_____
5. Feed/water		_____		_____
6. Death loss		_____		_____
7. Production loss		_____		_____
8. Other		_____		_____
SUBTOTAL				
SUMMARY				
A. Preparing for construction	_____	_____	_____	_____
B. 1. Construction	_____	_____	_____	_____
B. 2. Equipment	_____	_____	_____	_____
C. Operating Costs	_____	_____	_____	_____
TOTAL	_____	_____	_____	_____

Subcontractors (builders, equipment dealers, electricians, plumbers, excavators, etc.) can supply estimates of costs once you have developed plans for each option. Use this informatioan to complete the appropriate initial cost blanks in Table 5. The total initial cost of each alternative is obtained by summing the component initial costs. Cost overruns occur on many agricultural construction projects for a variety of reasons, including but not limited to unbudgeted construction is obtained by summing the component initial costs. Cost overruns occur on many agricultural construction projects for a variety of reasons, including but not limited to unbudgeted construction activity (e.g., excavation and site preparation) and unforeseen eventualities (e.g., ground water too high, soil conditions, weather, hidden structural features, etc.) Care must be given to include as many costs as possible when budeting a project. Contractors often will not give firm bids for remodeling projects because of the likelihood of unforeseen problems. Include contingencies for unforeseen costs in the "other" portions of Table 5.

Annual costs are operating costs plus annualized capital costs. Annualized capital costs include depreciation, interest, repairs, taxes and insurance. Table 6 lists some annualization factors which are multiplied by capital cost to yield annual cost. Structures usually are annualized over a 20-year period while equipment is annualized over a 10-year period. Equipment used in severe environments (manure handling) might best be annualized over a 7-year period. If a structure's use will be terminated in 10 years, structural changes should be annualized over that 10-year period. Equipment are items which have moving parts or are exposed to a higher likelihood of needing replacement than a structure. Examples of

equipment include furnaces, water heaters, vacuum pumps, stalls, certain waterers, feeding equipment, ventilation fans and curtains, etc. As an example, a structure with a remodel cost of $30,000 and an equipment cost of $40,000 would have an annual ownership cost of $12,800 ([$30,000 × 0.16] + [$40,000 × 0.20]) when the interest rate is 10%.

Table 6. Annualization factors for converting capital costs to annual costs.

Interest Rate (%)	**20-year Life**	**10-year Life**	**7-year Life**
		Annualization Factor[†]	
	0.11	0.16	0.21
6	0.13	0.18	0.22
8	0.14	0.19	0.23
10	0.16	0.20	0.25
12	0.17	0.22	0.26
14	0.19	0.23	0.27
16	0.21	0.25	0.29

[†] Assumes: repairs (2%), insurance (0.5%) and taxes (1.5%) of initial capital cost or outlay.

Operating costs also contribute to annual costs. They include but are not limited to fuel and lubrication, electricity, feed, bedding, veterinary, labor, waste handling, reduced productivity, etc. A remodeled facility may have some higher operating costs than a new facility because of compromises made to accommodate constraints inherent in an existing structure. These can be found in any of the operating cost categories but frequently are found in the labor, bedding, veterinary,and reduced animal productivity categories. The location of a structure will influence the amount of labor time needed to feed, bed and move animals and to remove manure. The degree of automation of these tasks influences the annual cost of owning and operating equipment. There is always a clash between labor and equipment costs. Where a piece of equipment is used for multiple activities (skid steer moves feed, snow, manure, bedding, etc.), the cost allocated to the activity is often less than when a piece of equipment is dedicated to one use (belt feeder, silo unloader, gutter cleaner, etc.) As many of the operating costs as possible for each alternative should be listed and estimated to obtain an accurate cost comparison among the alternatives.

Summary

The decision to remodel or use an existing structure vs. building a new facility must involve a considerable amount of planning to assure the decision is compatible with future plans and is truly as cost effective as initially perceived. This paper presents a ranking system to help decide if an existing structure should be considered as a remodeling candidate for a given application. If it is determined the building could be remodeled to satisfy a need, a partial budgeting analysis is used to determine the more economical alternative -- building new or remodeling.

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