SUBTERMINAL COSTS AND CHARACTERISTICS

By

Daniel L. Zink
Research Associate

UGPTI Staff Paper No. 29
December 1982

SUBTERMINAL COSTS AND CHARACTERISTICS

BY

DANIEL L. ZINK
RESEARCH ASSOCIATE

UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
NORTH DAKOTA STATE UNIVERSITY
P. O. BOX 5074
FARGO, NORTH DAKOTA 58105

DECEMBER 1982

TABLE OF CONTENTS

LIST OF TABLES

SUBTERMINAL COSTS AND CHARACTERISTICS

Subterminal elevators[1] are new in North Dakota relative to other Great Plains states. The introduction of multi-car and train-load rail rates for North Dakota-origin grain has spurred new construction and refurbishing of facilities as grain elevator owners and board of directors scramble to take advantage of the lower rates. A number of the subterminals have been newly constructed since 1980. Most of the current 50-54 car shippers[2] have new elevator facilities, although some were able to merely upgrade their existing elevator. On the other hand, most or all of the approximately 40 multi-car shippers now operating were able to upgrade their machinery, add bin storage or extend their rail siding in order to load multi-car trains. This new construction and upgrading has been occurring for reasons other than the multiple car rates, however. The average age of North Dakota elevators is 25 years, while 30 percent are over fifty years old. Therefore, replacement of facilities through the aging process has prompted new construction. Also, rail branch line abandonment has spurred relocation of elevator facilities as some operations are left void of rail service.

---

[1]A subterminal elevator will be defined herein as an elevator capable of loading grain unit trains and able to take advantage of the associated freight rate savings.

[2]Typical trainload shipments are in the lots of 50, 52, or 54 car lots, depending on the commodity shipped and the individual carrier. Similarly, multi-car shipments are generally in 24-27 car lots, also depending on the commodity and carrier.

The vast capital expenditure involved in construction of a new trainload shipping facility has prompted investigation of the financial viability of upgrading existing elevators and/or new investment. This paper deals primarily with the costs and characteristics of new subterminal elevators.[3]

PHYSICAL CHARACTERISTICS OF SUBTERMINALS

Size and service characteristics required of subterminal elevators will vary with the elevator patron's needs and the grain production and marketing patterns of the region. Various size and quality characteristics of subterminals are discussed in this section.

Minimum Investment Loading Facility

Continental Grain Co. has constructed a ramp-pit conveyor system as Hankinson, North Dakota for loading unit grain trains. This form of multiple car loading operation would be considered the lowest initial outlay type of facility that could potentially be built to load unit trains. The facility consists of a gravel truck ramp leading onto a steel unloading pit. The pit is emptied into rail cars by a gravel conveyor belt at a rate of approximately 10,000 bushels per hour. This type of "subterminal" has no storage, no office (at the loading site) and no elevation legs. The only components of the operation are the conveyor, steel pit, and truck ramp.

---

[3]Data contained in the following description of subterminal costs and characteristics were taken from Chase, Craig A. and Delmer L. Helgeson, "Cost Analysis of Potential North Dakota Subterminal Systems," Ag. Econ. Report No. 156 and UGPTI Report No. 44, NDSU, September 1982 and "Feasibility of the Cooperative Subterminal: A Case Study of Bisbee, North Dakota," prepared by Schrader-Lauth and Associates and the Upper Great Plains Transportation Institute for the North Dakota Department of Agriculture, July 1982.

A Hankinson-type operation requires sophisticated logistical coordination of incoming grain to effectively utilize the unloading facility and load the train within allotted times. Maximum coordination of incoming trucks must be attained to avoid queuing problems at the country elevators and the unloaded facility when grain is trucked in from area elevators or farms. The number of truckloads required to load a 52 car train necessitates organized delivery of the grain; a 52 car train of jumbo hopper cars holds approximately 171,600 bushels or about 200 semi truckloads.

The most obvious advantage of a Hankinson-type subterminal operation is the low initial investment costs. According to industry personnel (Continental and G.T.A.), the operation can be constructed for $70,000 to $150,000. The traditional concrete subterminal elevator with upright storage and leg facilities would cost many times that amount. Also, the Hankinson-type operation would likely require little time from ground-breaking to start of loading operations.

Labor requirements would be different than traditional country elevators. Current Hankinson-type operations utilize local part-time labor for loading, while supervisory grain marketing personnel located in regional offices arrange purchase and sale of the grain, as well as other organizational tasks. Total labor requirements may be less than traditional elevators because only the grain merchandising function is performed--none of the other peripheral elevator activities (such as storage) are performed.

The operation must still locate next to the required rail siding, but according to a Continental Grain representative, the conveyor is mobile, and 50 per cent of original investment costs are recoverable.

With the development of subterminals and evolution of multiple car rate structures, many country elevators ar concerned with losing their competitive edge due to the economies of transporting grain in unit trains from subterminals. A low cost Hankinson-type operation would not likely buy from farmers, but from existing country elevators, due to uniform quality considerations. Therefore, country elevators' autonomy may be preserved.

One obvious drawback of the operation is the lack of on-site office space and storage capability. The operation must rely completely on the organized inflow of trucks coming from existing area elevators. This requires sophisticated logistical organization of a trucking fleet to avoid waiting lines at the elevators and train loading site, and to get the required quantity of grain to the loading site within the allotted time period.

Exposure to inclement weather may be a problem for this type of loading facility. The ramp and approach may be effected by rain or snow. However, the actual loading process would not likely be restricted due to weather any more than an existing country elevator.

Other problems affected the long term feasibility of such an arrangement. It is not possible to blend grain at the loading site and the advantages of such merchandising flexibility may be lost. This lack of opportunity to combine price and merchandising alternatives and resulting lack of long term planning, may affect the competitive position of the subterminal.

TRADITIONAL SUBTERMINAL ELEVATORS

The minimum investment loading facility described above is not typical of the subterminal elevators generally constructed in the Northern Great Plains. The more standard facility is constructed with upright storage capacity of 300,000 to 500,000 bushels, on-site office space, automatic elevating and transfer machinery, and private or

leased rail trackage sufficient to accommodate trainload or multi-car shipments. Differences among the varying quality levels of subterminals (i.e. plain, standard, and deluxe) and their physical characteristics are presented below.

Plain Facility

It is possible to alter construction costs of the subterminal by eliminating some amenities that are not essential for the elevator to perform its basic function--to store and merchandise grain under the unit train system. Some of the areas of potential cost savings are a reduction in office space, reducing the size and capabilities of the scale and driveway facilities, and eliminating the drier and dust control systems. These areas of cost reductions may lower the initial construction costs by over 500,000 dollars. However, the consequences of these reductions should be considered relative to needs of elevator patrons. Services available would be curtailed in that the elevator can no longer dry grain for patrons; in North Dakota, recent sunflower acreage increases almost necessitate availability of drier facilities to producers, either on-farm or at the elevator. In-house efficiencies will also be reduced because of substandard scale and driveway operations and office space overcrowding.

Standard Facility

As stated previously, the typical subterminal facility being constructed has storage capacity of 300,000 to 500,000 bushels. Many elevators have two to three times this storage capacity, however this space was usually constructed prior to the introduction of the multiple car shipment concept and is often flat storage, not conducive to unit train loading operations.

The standard subterminal is normally equipped with fast load-out capacity, 10-15,000 bushels per hour (bph) for trucks and 40,000 bph for rail. This rapid load-out feature is necessary in order to load the required number of rail cars within the time period specified in the railroad tariff. The elevator also features a dust control system throughout the structure, aeration and temperature control systems for maintenance of grain quality, and a 1200-1500 bph drier system. The elevator's driveway is also equipped to handle incoming grain at the rate of 7,500 to 15,000 bushels per hour.

Deluxe Facility

The quality of a subterminal may be enhanced by adding increased office space, a more sophisticated dust control system, or expanded grain drier capacity. Also adding greatly to the cost of the facility would be an electronic scale and machinery monitoring system. The addition of these items would not only increase the in-house grain handling and merchandising capabilities of the operation, but may also contribute to expanded services to patrons of the elevator. A summary of the differences in construction costs of the different quality levels of subterminals is presented in Table 1.

TABLE 1. ALTERNATIVE CAPITAL INVESTMENT ESTIMATES FOR THREE SIZES OF SUBTERMINAL ELEVATORS.

	QUALITY OF FACILITY		
CAPACITY	**PLAIN**	**STANDARD**	**DELUXE**
BUSHELS	**- - - - - - - - DOLLARS - - - - - - - -**		
500,000	2,635,000	3,390,000	4,035,000
850,000	3,900,000	4,587,000	5,500,000
1,100,000	4,600,000	5,380,000	6,500,000

SOURCE: "Feasibility of the Cooperative Subterminal: A Case Study of Bisbee, North Dakota," prepared by Scrader-Lauth and Associates and the Upper Great Plains Transportation Institute for the North Dakota Department of Agriculture, July 1982.

SUBTERMINAL CONSTRUCTION AND OPERATING COSTS

As stated previously, subterminal construction costs may vary and will depend on the size of the facility and various complementary additions such as machinery and office space. The costs presented in this section are for the standard quality, 500,000 bushel capacity subterminal.

The total cost of constructing the 500,000 bushel, standard quality subterminal is 3,390,000 dollars (Table 2). Total annualized depreciable fixed costs constitute the majority of total annual costs of operation. Almost 60 percent of total annual costs are depreciable fixed costs. Variable costs of operation make up 13 percent of total costs while interest on variable costs and grain purchased constitute 15 percent of total costs.

The categorization of fixed and variable costs defined in Table 2 is done on an accounting rather than economic basis. The costs contained in the fixed cost section are generally thought to be constant over the firm's relevant range of output. The firm cannot, for example, alter its investment in elevator machinery in the short-run to expand its scale of operations. Similarly, variable costs will change in direct relation to output of the firm. For example, labor and electrical power expenses would be expected to increase or decrease as output of the firm changed.

An investigation of the variable cost accounts in Table 2 will indicate that portions of those costs are somewhat fixed in nature over a particular range of throughput. Although generally considered variable in nature in the economic sense, many will remain constant unless significant changes in output occur. For example, over $91,000 or 73 percent of total variable costs are salary related. Considering the seasonal variation in elevator

operations, management is not likely to make significant changes in the labor force with seasonal downswings in throughput. Therefore, a large portion of these variable costs would be fixed given a particular range of output. Some variable cost accounts which may be largely fixed in nature are labor, advertising, legal fees and residence expense, while power and rodent control may be more directly related to the volume of grain handled.

TABLE 2. ANNUAL CONSTRUCTION AND OPERATING COST OF A 500,000 BUSHEL CAPACITY SUBTERMINAL.

DEPRECIABLE FIXED COSTS

ITEM NAME	COST	NO.	LIFE	REPAIRS	SALVAGE VALUE	ANNUAL EQUIVALENT COST
Land (in acres)	$ 2,000.00[a]	10	40	$ 0.00	$20,000.00	$ 2,800.00
Elevator Structure	1,175,000.00	1	40	5,600.00	0.00	171,015.38
Driveway Structure	420,000.00	1	40	2,000.00	0.00	61,128.93
Elevator Machinery	550,000.00	1	10	2,600.00	0.00	108,082.69
Dust Control	125,000.00	1	10	600.00	0.00	24,564.27
Drier System	120,000.00	1	10	600.00	0.00	23,581.70
Electrical	150,000.00	1	10	700.00	0.00	29,477.11
Aeration and Temp.	50,000.00	1	10	250.00	0.00	9,825.70
Railroad Trackage (in feet)	60.00[a]	7,000	40	6,700.00	0.00	65,832.83
Railcar Mover	80,000.00	1	10	2,400.00	0.00	17,737.13
Office Building	60,000.00	1	40	300.00	0.00	8,732.70
Office Furniture	20,000.00	1	10	100.00	0.00	3,930.28
Contingencies	200,000.00	1	10	0.00	0.00	38,342.84
TOTAL DEPRECIABLE FIXED COST						$565,051.56
Construction Cost	$3,390,000.00					

NONDEPRECIABLE FIXED COSTS

ITEM NAME	COST	ANNUAL EQUIVALENT COST
Insurance	$18,488.00	$21,076.32
Bonds	5,100.00	5,814.00
Taxes	30,300.00	35,225.98
Manager Salary	30,000.00	34,199.98

TABLE 2. ANNUAL CONSTRUCTION AND OPERATING COST OF A 500,000 BUSHEL CAPACITY SUBTERMINAL.

Asst. Manager Salary	22,500.00	25,649.98
Director Fees	1,200.00	1,368.00
Dues	300.00	342.00
Annual Meeting	1,100.00	1,254.00
Warehouse License	50.00	57.00
TOTAL NONDEPRECIABLE FIXED COST		**$124,987.26**
TOTAL FIXED COST = $565,051.56 + $124,987.26		**$690,038.82**
VARIABLE COST		
ITEM NAME	**NO.**	**COST**
Bookkeeper	1	$10,400.00
Secretary	1	9,368.00
Laborers	3	43,680.00
Employee Benefits		17,390.00
Payroll Taxes		7,710.00
Unemployment Compensation		1,230.00
Workmen's Compensation		1,650.00
Office Supplies		4,000.00
Elevator Supplies		4,500.00
Power		11,000.00
Telephone		2,500.00
Subscriptions		600.00
Advertising		3,000.00
Special Meeting		500.00
Travel and Convention		4,000.00
Legal Fees		750.00
Rodent Control		520.00
Tax and Div. Work		500.00
Data Processing		800.00

TABLE 2. ANNUAL CONSTRUCTION AND OPERATING COST OF A 500,000 BUSHEL CAPACITY SUBTERMINAL.

Residence Expense		500.00
Protein Tests		1,500.00
TOTAL VARIABLE COST		**126,098.00**
Interest on Variable Cost		**10,718.00**
Interest on Grain Purchased [b]		**137,417.00** (256,511.00)
TOTAL OPERATING COST		**$274,233.00**
TOTAL ANNUAL COST (VARIABLE AND FIXED)		**$964,271.82** ($1,083,365.82)

[a]To arrive at total construction cost, multiply by the number of required units [i.e., land ($2,000/acre) (10 acres) and railroad trackage ($60/ft.) (7,000 ft.)].

[b]Assumes a turnover of 10.

Therefore, the high proportion of fixed costs suggested in Table 2 is further magnified by the "rigidity" of the so-called variable cost accounts. Expanding the throughput of the elevator would therefore involve a proportionately smaller increase in total costs relative to the costs presented in Table 2. Total variable costs at a turnover of ten (5 million bushels) were estimated at 126,098 dollars (Table 2), or an average variable cost of approximately 2.5 cents per bushel. Expanding output beyond a turnover of ten would involve a lower additional cost per bushel due to the fixed component of the variable cost accounts shown in Table 2.

Changes in costs of operation as output (bushels handled) was expanded are presented in Table 3. Additional costs attributable to increased volume were calculated by estimating the per bushel costs which varied directly with output and multiplying by the increased volume. The per bushel cost which could be directly related to changes in

volume was less than one cent. With the inclusion of interest costs on grain purchased and interest on variable operating costs, the additional cost of handling eight million rather than five million bushels was about 3.6 cents per bushel, compared to an average cost of 5.5 cents if the variable cost accounts are assumed to represent the costs directly varying with output.

The relative fixed cost/variable cost mix of a firm has direct implications on the financial success of the operation and various levels of output. The high fixed cost nature of subterminal elevator operations exemplifies the need for high volume and maximum utilization of capacity. For example, the average total cost when volume handled is five million bushels is 19.29 cents, but decreases to 13.40 cents when throughput is eight million bushels. Unit cost drops further to 10.72 cents when output goes to 11 million bushels. This relationship between throughput and average cost of operation should serve as a caution to elevator management that, once the investment in a new facility is made, high throughput is critical to the operation's financial viability.

TABLE 3. PER BUSHEL OPERATING COSTS FOR DIFFERENT LEVELS OF OUTPUT, 500,000 BUSHEL CAPACITY SUBTERMINAL.				
	VOLUME HANDLED (BUSHELS)			
	5,000,000	8,000,000	11,000,000	16,0000,000
	(BASE CASE)			
Costs Incurred From				
Handling Base Case Volume				
Total Fixed Cost	$ 690,039	$ 690,039	$ 690,039	$ 690,039
Total Variable Cost	126,090	126,090	126,090	126,090
Interest on Variable Cost	10,718	10,718	10,718	10,718
Interest on Grain Purchased	137,417	137,417	137,417	137,417
TOTAL	**964,264**	**964,264**	**964,264**	**964,264**
ADDITIONAL COSTS ATTRIBUTABLE TO INCREASED VOLUME				
Fixed Cost	--	--	--	--
Variable Cost[a]	--	23,100	46,200	84,700
Interest on Variable Cost[b]	--	1,964	3,927	7,200
Interest on Grain Purchase[c]	--	82,450	164,900	302,317
TOTAL	--	**107,514**	**215,027**	**394,217**
TOTAL COST	**$ 964,264**	**$1,071,778**	**$1,179,291**	**$1,358,481**
AVERAGE TOTAL COST	**.1929**	**.1340**	**.1072**	**.0849[d]**

[a]Variable costs attributable to increased output were computed assuming an additional unit cost of $.0077 per bushel.

[b]Interest computed on the **additional** variable cost only.

[c]Interest computed on the **additional** grain handled only.

[d]A throughput of 16 million bushels (turnover = 32) would be unattainable for most North Dakota elevators, but was included to emphasize economies of utilization from high throughput.