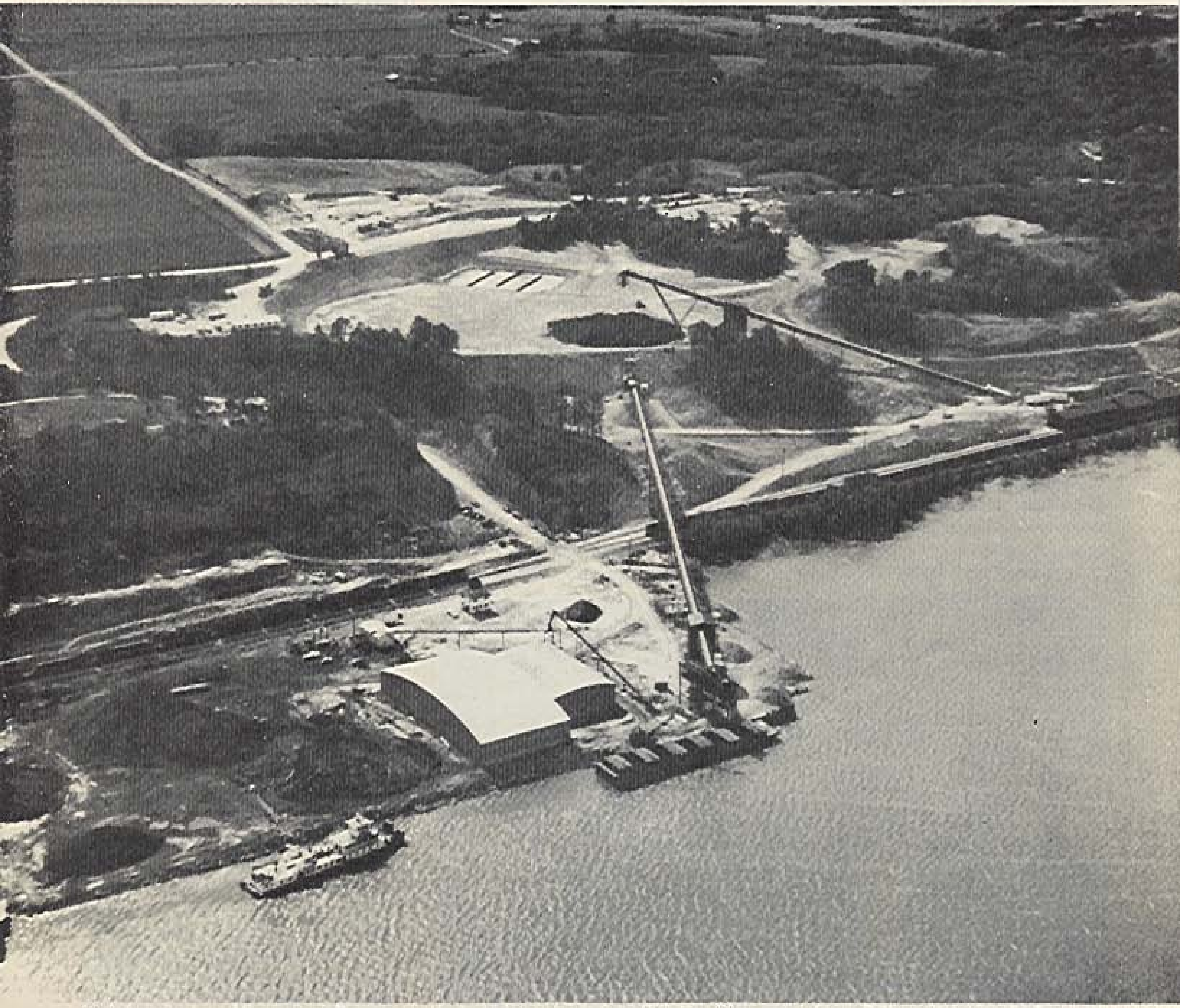
Skillings' Mining Review

REPRINTED FROM
FEB. 2, 1980
VOL. 69 NO. 5
Established 1912

PUBLISHED EVERY SATURDAY MORNING



Link terminal on Mississippi River near Keokuk, Iowa, transfers Gillette, Wyo., coal from B.N. unit trains to barges.

A Purpose-Oriented Approach to Transshipment Terminal Development

A Purpose-Oriented Approach to Transshipment Terminal Development

by DR. A. T. YU, P.E. and DANIEL MAHR, P.E.
PRESIDENT ORBA CORP. PROJECT MANAGER ORBA CORP.

Will we be able to supply the raw materials necessary to maintain the standard of living? Billions of dollars will be needed just for mid-America's ports. [1] Because transportation is a major component of the gross national product, [2] users of raw materials the world over are evaluating transshipment schemes to help reduce product cost. Evaluating these schemes is a complicated process as a result of the many factors that impact supply decisions.

A Purpose-Oriented Approach, POA, can be a useful tool. It defines the purpose of the transshipment terminal within the transportation system to help eliminate extraneous factors. It focuses attention on economics, from mine to product. Only by considering all economic impacts can the user hope to optimize cost reductions. The POA also examines how the transshipment facility can meet today's demands and tomorrow's uncertain requirements. Finally, a methodology is incorporated to develop the transshipment idea into a reality. By using this approach, the many complex issues will be confronted. Each will be ranked by impact and urgency and logically solved in an astute program.

A prime example of the Purpose-Oriented Approach applied to a coal transshipment facility is the Superior Midwest Energy Terminal. In less than 25 months, the necessary environmental approvals were obtained, an economical financial package was prepared, and the $45 million transshipment terminal was engineered, built and placed in operation. The ability of this terminal to take advantage of attractive carrier rates was the reason that Detroit Edison signed a 26-year coal contract with Decker Coal Co. and invested a total of $307 million in capital equipment. [3] In testimony to the significance of the Superior Midwest Energy Terminal, it has received the most prestigious awards from two highly esteemed U. S. engineering societies:

- The American Society of Civil Engineers, 1977 outstanding civil engineering achievement award. [4]
- The National Society of Professional Engineers outstanding engineering achievement award for 1976, one of 10 projects named. [5]

This is the first, ever, for a transshipment terminal. The awards place the terminal in prominent company. Other engineering achievements that have been honored are the Alaskan oil pipeline, the Viking Mars landing project, and the St. Lawrence Seaway.

Fig. 1—Pride Transloader is a processor terminal situated in Pride, Ala. It receives and blends high, medium and low sulfur coal to provide Georgia Power with an environmentally acceptable and economical fuel. The different coal piles can be seen in the evening view of the stockpile and stacker.

THE PURPOSES OF A TERMINAL

A transshipment terminal serves one or a combination of several purposes. They are: "link," "warehouse," "distributor," and "processor." The "link" terminal is an intermodal transportation facility that literally links two different modes of transportation. The "warehouse" provides storage for system fluctuations between supplier and consumer. The "distributor" serves as an efficient shipping focal point. The "processor" has the capability to add value to the product. By determining the primary function of the terminal, efforts will be directed efficiently to resolve major issues first.

The "link" transshipment terminal occurs at the interface of different modes of transportation. This terminal may be rail-to-river barge, truck-to-rail, rail-to-ship, or any of several other combinations. Its distinctive feature is the ability to satisfy the requirements of different transportation lines while maintaining an efficient operation. The "link" terminal must cater its services to the rate structure of transportation lines. Serious consideration must be given to demurrage versus terminal charges. Not only are there differences between modes, but also there are often different rate structures within a single mode. Rail is an excellent example. Demurrage for a random rail car train may be absorbed easily for several days while a unit train operation typically will incur substantial penalties if not turned around in four hours by the terminal.

In June 1979, a "link" terminal, which appears on the front cover, was commissioned on the west bank of the Mississippi River near Keokuk, Iowa. This facility receives Gillette, Wyo., coal from Burlington Northern unit trains and transfers it to river barges. The terminal supplies coal to Interstate Power Co.'s Lansing, Iowa, generating plant, as well as third-party user tonnages. The combination route takes advantage of attractive unit train and barge rates. The unit trains must be unloaded within four hours to avoid demurrage and qualify for the unit train rate. The site was selected to "hold down transportation costs." (*)

The desirability of a "link" terminal may not be apparent at first glance. A more direct route or the availability of a single mode of transportation may appear to be the logical solution. It is not until cost comparisons and reliability considerations are examined that the advantages of a "link" terminal are appreciated. The real criteria, cost and reliability, then easily overshadow other aspects.

The "warehouse" terminal is designed as an economical site for storage. It may mitigate the effects of seasonal fluctuations of supply as grain terminals do between farmer and baker. It may smooth peak consumer demand periods, Christmas, for instance. The "warehouse" terminal also may serve as storage to moderate the effects of interruptions in transportation. These may be expected, as the freezing of the upper Mississippi and the Great Lakes, or unexpected, as supplier or carrier strikes. The warehouse function of a terminal can be highly sophisticated, such as the many computerized systems being used for selecting, stacking and retrieving containers in a yard capable of housing hundreds of units.

ADVANTAGE OF DISTRIBUTOR TERMINAL

The "distributor" transshipment terminal offers customers the advantage of volume. Volume applies to both product cost and transportation charges. Within an economical geographic area, a "distributor" terminal can forward a product at a lower cost than the customer can obtain directly. Again, it is the delivered cost and not the direct route that is of prime consideration.

The Keokuk facility and the Pelican Island bulk terminal, Galveston, Texas, illustrate how the low volume consumer can benefit from the "distributor" terminal. The low volume coal user, one that usually purchases less than 350,000 tons of coal per year, is faced with several problems while negotiating fuel supply. Its plant may not have the storage capacity necessary to receive large lot shipments. Plant

FIG. 2—TRANSSHIPMENT TERMINAL COMPARISON

Feature	Unit (Container)	Bulk
Direction	Bidirectional	Usually one way
Storage Inventory Control	Complex	Simple
Environmental Control	Minimal	Extensive
Users	Many Products (Standardization)	Usually one product category
Measurement	Units	Tons, bushels
Product Value	High	Generally low
Added Value	Very Low	Low but can have significant impact
Capacity (tons)	Low	High

equipment may not be adequate to unload the carrier within the typical time period or be available on the normal 24-hour basis. The user may not be accessible to the most economical carrier or transportation mode. The yearly tonnage itself makes obtaining the best f.o.b. mine price difficult. The Keokuk facility and the Pelican Island terminal, by combining the needs of many users and being strategically situated, will solve these problems. They will be able to allocate operating and capital costs over a wide base and thereby deliver coal at a lower cost than the consumer can obtain otherwise.

The "processor" transshipment terminal performs a unique operation to add value to the product. For coal or iron ore, it may be a blending operation to meet user or government requirements. The terminal performs a vital operation and increases product value.

The Pride Transloader, Pride, Ala., shown in Fig. 1, and the Inland Gulf Terminal being developed on the Ohio River near Owensboro, Ky., are processor facilities for the power industry. The cost of energy is increasingly becoming a burden. Both fuel supply and emission control costs are severely impacting electric rates. Compounding utility problems is the fact that coal's properties greatly vary from region to region and even mine to mine. These facilities offer the solution: prescription coal. By accurately blending several types of coals, they can supply coal whose properties are prescribed to best meet plant requirements. Not only can the utility specify the B.T.U., fusion point, and ash content to best meet boiler characteristics, but also it can limit sulfur content as an economical alternative to scrubbing technology. The use of economical unwashed high sulfur coal is of particular interest to the fuel supply manager because it lowers coal's unit price to help the utility maintain rates.

As the real world rarely permits anything to be neatly and conveniently categorized, most transshipment terminals are a combination of two or more types. For example, the Superior Midwest Energy Terminal combines the attributes of the "link" and "warehouse" terminals. It links unit trains to Great Lakes self-unloaders. Because the lake shipping halts during the four winter months but rail receipts continue, the Superior terminal must also function as a warehouse. It is engineered to store up to 7,000,000 tons of coal. (*) Recognizing the individual types within a terminal and ranking each provides a priority list. This list determines the attention and investment each type should be allocated.

TERMINAL IN A TRANSPORTATION SYSTEM

Transportation is a major component of the economy. Every consumable item must be transported not once but quite often many times. Elements in the transportation system may stretch from the mine where the iron ore is extracted, to the beneficiation plant, steel mill, manufacturer, wholesaler and retailer.

To visualize more easily the raw material to finished product chain, it is best to segment the chain into unit and bulk categories. Unit applies to goods, whether in process or finished, that can be packaged individually, skid-mounted or containerized. Bulk applies to iron ore, coal, grain or other commodities that can only be handled economically in a loose mass. The significant differences between unit and bulk are summarized in Fig. 2, transshipment terminal comparison. Several striking differences can be noted. The unit terminal can be described as having relatively low volume but high value products. Its environmental restraints are minor, but the inventory problems are complex. The bulk terminal handles a generally low value product, but its throughput volume is high. Its inventory problems are minimal, but the environmental concerns are substantial. One type of terminal is the antithesis of the other, but both are necessary to the manufacture of products and complement each other at ports throughout the world. Using these two broad categories, unit and bulk, facilitates analyzing transportation without becoming entangled with the many different industries that independently operate within the transportation system. Understanding the many factors that impact the facility will insure that market objectives are realistic. The effects of competition, government and economic trends cannot be dismissed.

The Lorain pellet terminal on Lake Erie, illustrated in Fig. 3, demonstrates how companies like Republic Steel Corp. constantly are examining their transportation system and striving to reduce delivered cost and improve service. Republic identified the economies of the new 1000-ft. lake vessels as a distinct advantage in shipping iron ore to its Ohio plants. It is, however, impossible to merely upgrade the shipping fleet. The narrow, winding Cuyahoga River, which serves the plants, is a major obstacle. Republic elected to build a new transshipment facility at Lorain, Ohio. The terminal is being built to receive pellets from the superships. It will stockpile the pellets to compensate for the freezing of the water route. The terminal will also load both river vessel and trains. Republic Steel has, therefore, given the transportation system added dimension and flexibility while reducing delivered cost. It is establishing a link-warehouse transshipment terminal to accomplish this.

ECONOMICS — THE CENTRAL ISSUE

The definition of the terminal is important but what one fact will make the facility a viable enterprise? What are users most interested in? The central issue is total cost; that is what counts. This cost consists of five components:

- Production (f.o.b. producer).
- Transportation.
- Terminal capital cost.
- Terminal operating cost.
- Process cost.

Terminal capital cost is only one component of the total cost. Quite often, it may not even be a major factor. This is true for both manufactured components, which have a high product value, and bulk products, which have a high transportation cost, often between 30% to 60% of total cost. ([a]) Using the total cost to determine the viability of the transshipment terminal should focus attention initially on reducing product, transportation or process cost. These categories govern overall economic attractiveness. Minimizing terminal charges will help, but if the other substantial advantages are not evident, then minimizing terminal charges cannot be effective. In other words, a macroeconomic view must be taken.

The macroeconomic view of transportation can be applied to both bulk shipment and containerized shipment. Detroit Edison's low sulfur coal movement through the Superior Midwest Energy Terminal is an excellent example. Low sulfur coal was determined by Detroit Edison to be more economical than other coal (product cost) and environmental control technologies (process cost). In addition to this product and process economic advantage, the transportation route is credited with reducing delivered cost by $6 to $8 a ton. ([a]) Projecting this cost over the 200,000,000 tons contracted to be delivered over 26 years, the transportation cost savings alone will be in excess of $1 billion!

Site selection should consider many factors. Often compromises are necessary because all desirable features will not be available at any one site. Farsighted authorities, like the port of Galveston, Texas, have examined closely the best advantages. Galveston has developed excellent rail and truck systems to serve the port, where lengthening of the existing channel and dredging it to 54 ft. also are under way. To speed deliveries, the Galveston connection was developed. It is a container system that allows cargo

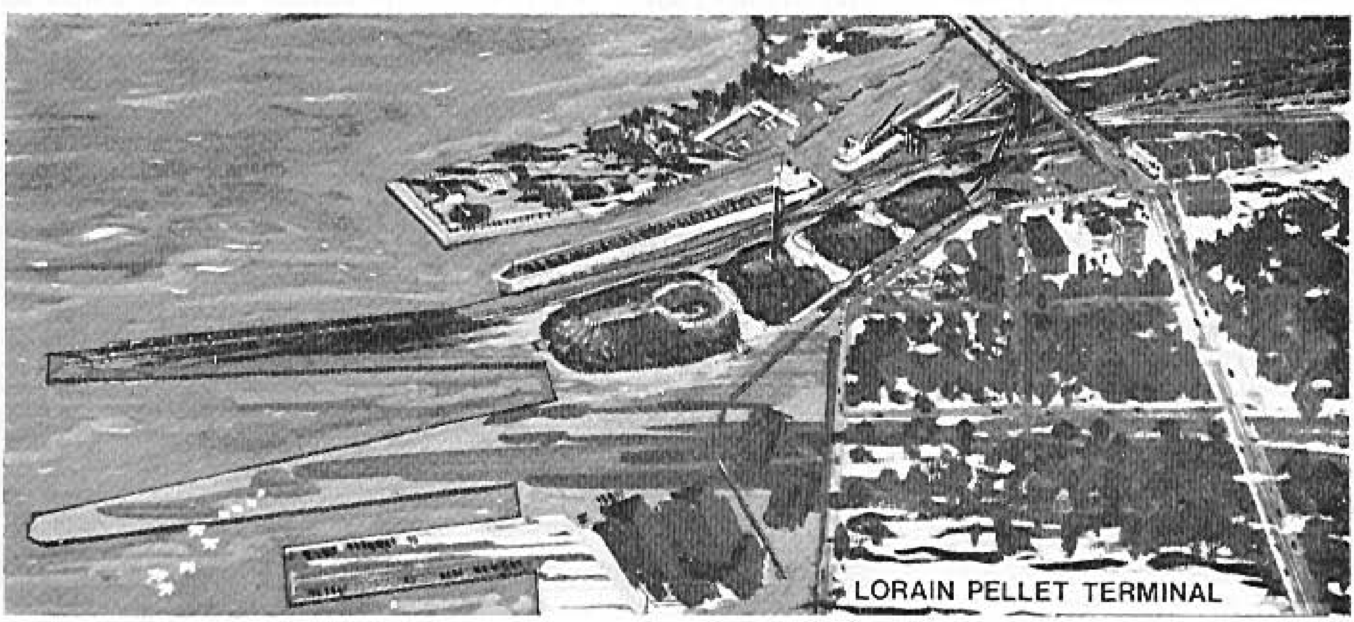


Fig. 3—Artist's rendition of Lorain pellet terminal developed by Republic Steel to reduce transportation cost. The facility accommodates 1000-ft. self-unloaders, stores pellets, and loads both river vessels and rail providing an economical and flexible transportation system.

to be placed aboard ship the same day that it is delivered. Galveston is also one of the few world ports to offer complete services under one management. ([10])

Carefully planning the transshipment terminal is cost effective. In ORBA's experience, the cost of a plan is less than 1% of project cost and has resulted in savings of as much as 33% of capital cost. The Two Harbors taconite terminal of D.M.&I.R. Ry., a subsidiary of U.S. Steel, is an excellent example. Capital cost estimates were slashed from $52 million to $35 million. ([11]) The ORBOOM, illustrated in Fig. 4, was conceived specifically for that terminal. It was the key factor that reduced capital costs to an acceptable level. The ORBOOM helped make the revitalization of this historic 60-year old terminal a reality. The terminal was recognized by the National Society of Professional Engineers as one of 10 outstanding engineering achievements for 1978. Although developed for D.M.&I.R., the ORBOOM can be applied to any pocket dock installation. Capital cost is important; however, it should not divert attention from the central issue, total cost.

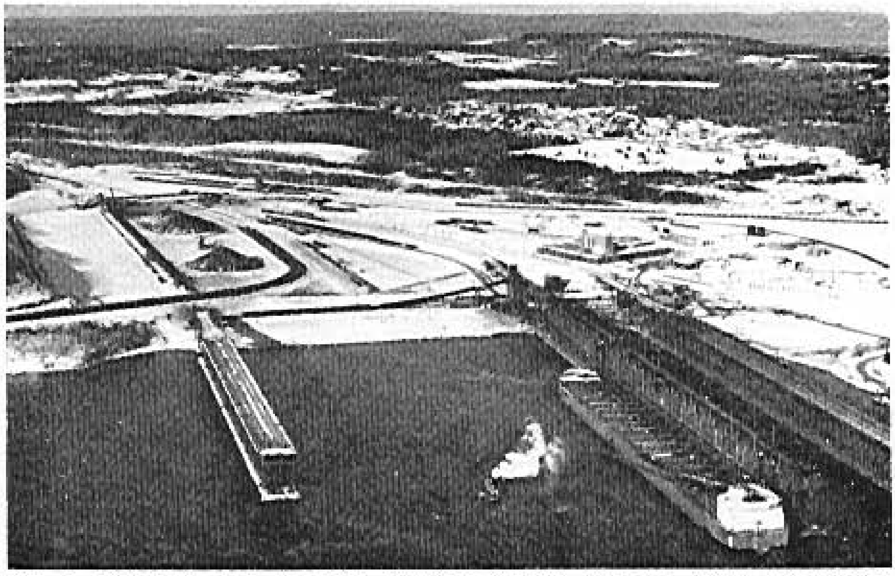


Fig. 4—D.M.&I.R. Ry.'s taconite terminal in Two Harbors, Minn., where the patented ORBOOM shiploading system reduced capital cost to make revitalization economically feasible. In 1978, this was one of 10 projects honored to receive an outstanding achievement award of N.S.P.E.

SIMPLICITY — RELIABILITY — FLEXIBILITY

After identifying the purpose of a terminal and evaluating the central issue, three elements that should be considered to satisfy a user's objective are: simplicity, reliability and flexibility. Often, simplicity in design will lead to reliability and flexibility.

The Superior Midwest Energy Terminal is an eloquent illustration. To ensure its completion within a stringent two-year requirement, the simplest possible system was conceived. Simplicity resulted in reduced engineering time, the least number of components, and minimum number of conveyor transfer points. Minimized use of machinery and supports helped to reduce construction time and environmental impact. This philosophy also was applied to reliability. All nine conveyor drives, for example, were standardized as identical 500 hp. units. Multiple drives were utilized as required. Now, the terminal stocks just one complete spare conveyor drive to guarantee a ready replacement. This greatly simplifies inspection and facilitates preventive maintenance and repair.

Flexibility also leads to many other benefits. The past few years have been punctuated with the dramatic events such as the oil embargo and the opening of the People's Republic of China. The ability of a system to respond to unforeseen pressures is a distinctive benefit. Adapting to changing markets, product mix, volume, carriers and carrier equipment can put the terminal in the enviable position of being in the right place at the right time.

One flexible terminal, the result of increased usage of a port with limited expansion area, is Chile's Coquimbo port. Antiquated shiploading costs were unacceptably high. To mechanize the operation and maximize the usage of the available dock space, a mobile shiploading system was devised to load iron ore rapidly. This system can be rolled aside when not in use, giving the dock the dual capability of bulk and heavy general cargo. ([12])

TIE IT TOGETHER WITH A MASTER PLAN

With the terminal defined, and its economics in terms of reducing total cost confirmed, a master plan should now be developed. This plan draws upon the best available information to detail the facility that best satisfies industry requirements and market projections. It should incorporate simplicity, reliability and flexibility. The plan should examine contingency alternatives. It should determine the effect and reaction to a 10%, 20% or 40% swing of throughput volume. In short, the master plan projects the transshipment terminal into several situations. It is more encompassing and enlightening than a feasibility study, because several paths are pursued and evaluated. Often when relationships are too complex to be illustrated by equations, the master plan is then best completed with a computer simulation of the transshipment terminal. Advantage can be taken of the computer's ability to spew a complete record of every situation just by varying parameters. This assumes, of course, that the statistical descriptions, attributes of the entities, and model priorities are defined conceptually to accommodate all appropriate possibilities. Properly used, a terminal simulation will, within the procedural framework, scrutinize the conditions and reactions of the terminal as it services arriving transportation modes. ([13])

The master plan may employ one of three basic tactics: optimistic, pessimistic, strategist. Each subscribes to a different corporate ideology of opportunity and risk. Each incorporates the classic economic relationships of fixed and variable costs. The benefits and disadvantages of each are illustrated and described in Fig. 6, cost comparison.

After analyzing the industry, the market and the facility itself, the prospects of the transshipment terminal should now be clear. If unfavorable, needless to say, other more lucrative ventures should be investigated. If the analysis proves the terminal to be a profitable opportunity, only then is it time to commit funds.

IMPLEMENTING THE PLAN

To make the transshipment terminal a reality, an implementation program is required. The program should define what, where and when.

This reduces the risks normally attendant to any construction project and still provides freedom for the contractor to determine how the goals may be met best. Major elements of the implementation program include an economic review, permit application, engineering, procurement, construction and commissioning.

If a full economic evaluation has not been incorporated, it is now prudent to commission a feasibility study. This engineering study should confirm capital and operating cost. Both are important. Decisions should not be made on a capital cost alone because the significance of operating cost is equal to that of capital cost.

The most economical terminal is one in which the operating charges equate to the annual capital recovery cost. In Fig. 7, the approximate cost is derived for handling 5,000,000 tons per year by several different hypothetical bulk transshipment terminals. As capability increases, both operating and capital costs increase. Several assumptions are made and all operating costs are categorized as hourly to simplify this example. Fig. 8 graphically illustrates these costs. It indicates that the most economical terminal to handle a throughput of 5,000,000 tons per year is one whose capability is about 4000 t.p.h. and has a total cost of about $1 per ton. This figure, of course, depends on many factors including site soil conditions, local labor rates, and corporate financing capability. For other throughputs, similar calculations will indicate what terminal is best suited for those assumptions. The evaluation of an actual terminal would include a sensitivity analysis to determine the capacity that most economically handles the anticipated range of throughput. It would also consider the requirements of the interfacing modes of transportation. An advantage of this thorough economic evaluation that should be considered is that it demonstrates the forethought given the project, and provides a rational basis for action.

PUBLIC APPROVAL IN FORM OF PERMIT

In the last 20 years, the public has become aware of industry and industry's effects. Public approval in the form of a multitude of permits is required to protect the environment, safeguard the public,

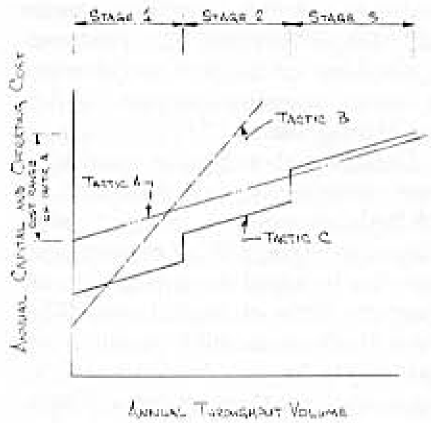


Fig. 6—Cost comparison graph.

and insure that neighbors express their concerns. Because an unexpected detrimental effect may delay construction, increase costs, or abort the project completely, permits should be applied for expeditiously. By examining the issues before submittal and incorporating those features that meet agency requirements, the applications have the best opportunity of being accepted without lengthy revisions and delays. Delays themselves can be a substantial cost.

High escalation and construction interest rates are increasingly impacting project costs. One method used to reduce their impact is to minimize the implementation period. The specification of the project, for instance, could be initiated at the same time as permits. This can reduce the schedule by several months. The objective of project specification is to itemize and stip-

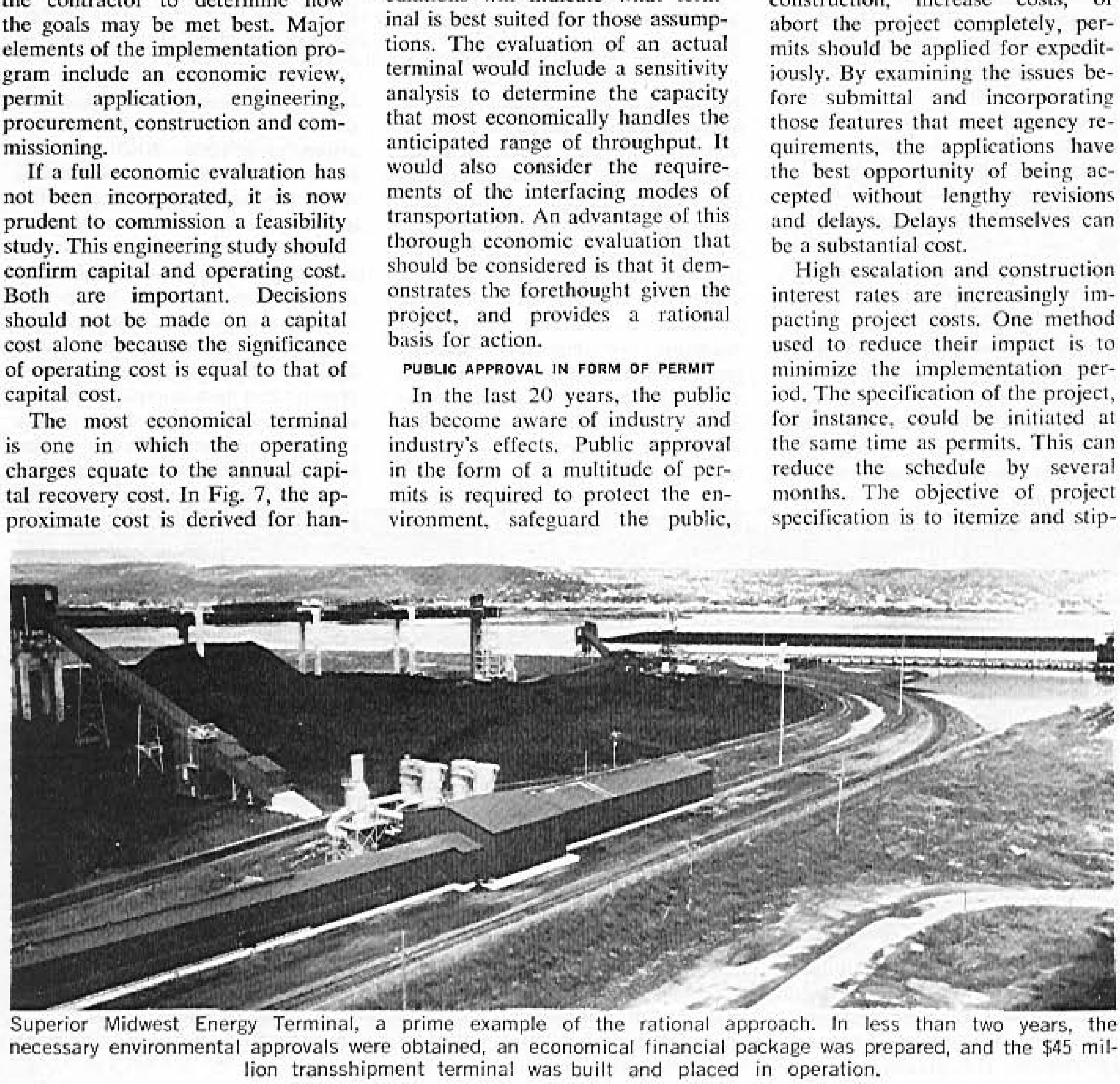

Superior Midwest Energy Terminal, a prime example of the rational approach. In less than two years, the necessary environmental approvals were obtained, an economical financial package was prepared, and the $45 million transshipment terminal was built and placed in operation.

FIG. 6—COST COMPARISON

Three tactics may be incorporated into a master plan: optimistic, pessimistic and strategist. The selection of one largely determines the facility's future potential. The graph of each tactic illustrates how fixed cost (predominantly capital cost) and variable cost (predominantly operating cost) affect the economics of the facility.

Tactic A, optimistic, is utilized best when large throughput volumes are assured. As seen, it incorporates a large fixed cost with a low variable cost. This is typical of an extensive, automated system. It has several distinct benefits. At high throughputs, it is the most economical. The variability of its cost range is very narrow; therefore, costs are highly predictable. Because a substantial percentage of cost is allocated to a fixed category, as a mortgage for instance, escalation is reduced because it largely applies only to the variable portion. Tactic A, therefore, has several economical advantages and is highly predictable. The major disadvantage of Tactic A is its inability to accommodate prudently low throughput volumes. It should only be used where high throughputs can justify the initial fixed investment.

Tactic B is defined as pessimistic. Its low initial investment is appealing; but, because it results in a correspondingly steep variable cost, it is doubtful that Tactic B would ever result in a major transshipment terminal. At low throughput volumes, Tactic B is most economical utilizing a minimum amount of equipment and personnel. As throughput volume increases, however, the additional variable expenses incurred as either terminal cost or demurrage quickly make it uneconomical. The steep slope of variable cost also makes specific costs difficult to predict accurately as volume fluctuates.

Tactic C, strategist, subscribes to the advantages of both A and B while mitigating their weaknesses. Its initial fixed investment is relatively low and its variable cost range is relatively narrow. Tactic C can incorporate these by featuring a master plan that provides staged expansion and automation, as warranted by increases in throughput. Tactic C is clearly advantageous to the entrepreneur who desires to penetrate into a new or expanding market. It should be noted, however, that cornerstones of business-like utilities also use Tactic C. Electric power generation plants are designed normally as multiple units that are added to maintain reserve generating capacity as demand increases. Tactic C does take more forethought than either A or B; but, its benefits over the 20, 30, or 40-year life of the project will be substantial. The staged growth of Tactic C is also essential to most engineering designs because their neglect is likely to lead to costly corrections.

ulate the complete project. It applies to such diverse considerations as quality level, equipment selection, contractor responsibilities, and payment terms. Its purpose is to avoid the construction pitfalls by developing a document that specifies every feature of the facility and its construction. The document becomes the contract by which all disputes are arbitrated.

The next step in the implementation plan is engineering the facility in detail. The engineer's charge to safeguard life, health and property ([14]) clearly defines his principal responsibilities. It is, however, not sufficient to merely design the facility to meet engineering standards or those published by the U. S. Department of Labor. ([15]) The engineer must be cognizant of operating methods. A transshipment terminal is built only once, but the operator must live with it daily.

Any design, regardless of how safely it may have been engineered, will become a hazard if it encumbers operation. The pressure of production can precipitate short cuts that border prudence. The experience of operators should, therefore, be actively sought and their valuable insights incorporated into the final design. Design engineering should also not be confused with textbook equations or selection of equipment. It should be practical and innovative. If existing equipment does not fit the system, innovative engineering should be used to design suitable components. Operational advantages must not be sacrificed merely to use existing product lines.

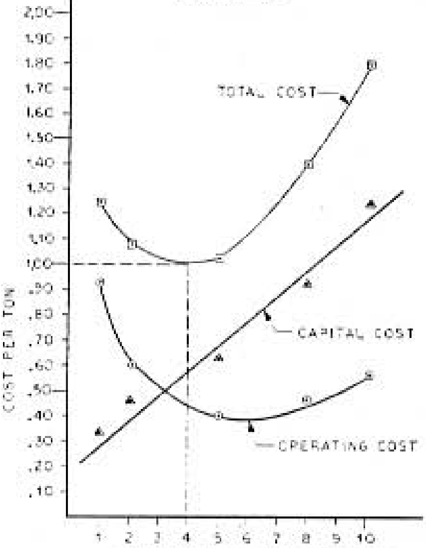
Procurement, the purchase of all equipment and services, utilizes the contract as the unit of measure. The purchasing manager's first charge is the interests of his company. ([16]) The procurement function, therefore, must join the objectives of the contract to those of the company. Price, delivery dates, and payment terms must all be reconciled to insure that the best value is obtained.

CONSTRUCTION SCHEDULE CALCULATION

Construction methods should be examined closely to provide the best schedule. Construction may be accelerated to finish before craft negotiations expose the project to strikes. The schedule may also be shortened to reduce the possibility of escalation, consequential damages, and liquidated damages. On the other hand, the schedule may be extended intentionally to smooth manpower loading or construction equipment requirements. These and other considerations must be balanced to produce the one construction schedule that minimizes cost.

This is illustrated by Fig. 9. The curves are based upon the assumption that there is an optimal timetable and that by either accelerating or extending it, additional costs will be incurred. Because cost and risk normally are not coincident, separate ratios are illustrated for each. By considering both cost and risk ratios, the effective cost ratio can be determined. Other than the unlikely event that a minimum risk occurs at the same time a minimum cost is anticipated, the minimum effective cost ratio will always be greater than unity. This reflects in monetary terms the effect of timing

FIGURE 8



COST GRAPH OF VARIOUS TERMINALS
(OPERATING AT 5,000,000 TPY)

Fig. 7—Comparative Annual Cost of Various Hypothetical Bulk Terminal Designs
(Based upon an annual throughput of 5,000,000 tons)

CAPABILITY IN TONS PER HOUR	1000	2000	5000	8000	10,000
Operating Cost:					
Efficiency	.65	.65	.65	.65	.65
Hours of Operation	7,700	3,800	2,000(1)	2,000(1)	2,000(1)
Operating Cost per Hour	$600	$800	$1,000	$1,200	$1,400
Operating Cost per Year	$ 4,600,000	$ 3,000,000	$ 2,000,000	$ 2,400,000	$ 2,800,000
Operating Cost per Ton	$0.92	$0.60	$0.40	$0.48	$0.56
Capital Cost:					
Initial Investment	$10,000,000	$15,000,000	$20,000,000	$30,000,000	$40,000,000
Annual Capital Cost at 15% for 25 years	$ 1,600,000	$ 2,300,000	$ 3,100,000	$ 4,600,000	$ 6,200,000
Annual Capital Cost per Ton	$0.32	$0.46	$0.62	$0.92	$1.24
TOTAL COST PER TON: (2)	$1.24	$1.06	$1.02	$1.40	$1.80

(1) Normally 2000 hrs. is used to reflect the minimum number of hours for a one shift operation.
(2) Total cost per ton = operating cost per ton + annual capital cost per ton.

on the risk and cost factors inherent in any project. While exact figures would be difficult and time consuming to compile, the use of Fig. 9 may temper the arguments of an over-zealous optimist or pessimist with reality.

The progression from project specification to engineering, procurement and construction is paced classically so one act precipitates another. Sometimes the luxury of this is prohibitive. The shiploader for the Superior Midwest Energy Terminal, as an example, was one item on the two-year critical path schedule that required a different approach. Just six weeks after commencement of the project and nearly a year before ship profiles were available, the shiploader was ordered. Construction too could not wait for completion of engineering but progressed on a parallel schedule.

An important aspect of the implementation program is commissioning. The transition from construction to operation should be viewed as an educational process for the operators and a debugging tool for construction. By participating in commissioning, operators can gain insight into system idiosyncrasies as well as an appreciation for its value and the problems that can occur.

The culmination of the Purpose-Oriented Approach is placing the

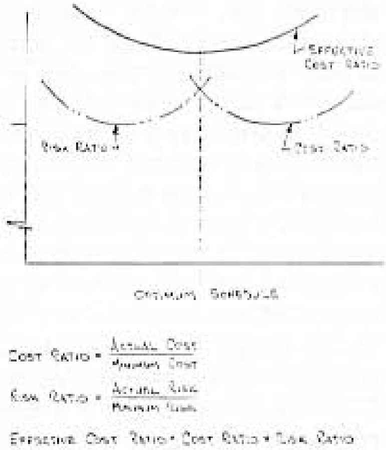


Fig. 9—Optimum schedule graph.

transshipment terminal into operation. The months of research, analysis, planning and implementation have transformed an idea to reality.

As we have seen, the Purpose-Oriented Approach to transshipment terminal development recognizes the important role a transshipment terminal plays in a transportation system. For both the producer and the user, the Purpose-Oriented Approach draws upon a wide range of sources to reduce cost and provide a valuable service. It substitutes imagination based on pragmatism for textbook approaches. A compendium of the Purpose-Oriented Approach that has been a helpful guide is, "The emphasis on material handling equipment obscures the real problem: the handling of material." [17]

FOOTNOTES

1 Maritime Administration — Department of Commerce, Mid-America Ports Study, (June 1979), p. 16.

2 U. S. Bureau of the Census, Statistical Abstract of the U. S., (1978), p. 443.

3 "I.C.C. Investigates B.N. Rate Hike Application," Coal Week, Vol. 5 No. 11 (March 12, 1979), p. 9.

4 American Society of Civil Engineers, News, (Dallas, Texas; April 27, 1978).

5 National Society of Professional Engineers, News of the Engineering Profession, (Washington; March 23, 1977).

6 "Work Under Way on Coal Facility," Fort Madison Evening Democrat, (April 6, 1978), p. 1.

7 A. T. Yu, "Bulk Transportation — A Bicentennial Year Review and Outlook," Skillings' Mining Review, (Dec. 18, 1976), p. 5.

8 A. T. Yu, "Fine Grind — The Key is Still Economics," Mining Engineering, (May 1975).

9 A. T. Yu, "Mammoth Transshipment Terminal Links Montana Coal to Michigan Power Plant," Civil Engineering, (Jan. 1977).

10 Port Galveston Annual Report Issue, (Aug. 1976), passim.

11 Richard A. Schumann, project manager, ORBA Corp., Interview, (April 4, 1979).

12 A. T. Yu, "Chile's Coquimbo Port Installs Mobile Loading Facilities," Mining Engineering, (May 1964).

13 C. H. Ricker, "Bulk Handling System Simulation," Society of Mining Engineers, spring meeting, (1974).

14 "Revised Statutes — Title 45:8," State of New Jersey, Roster Licensed Professional Engineers and Land Surveyors, (Sept. 30, 1978) p.i.

15 Department of Labor, Federal Register, (May 29, 1971).

16 Joseph R. Megliola, ed., "Principles and Standards of Purchasing Practice," Guide to Purchasing, Vol. 2 (New York, 1974).

17 A. T. Yu, "A Profit-Oriented Approach to Bulk Material Handling," Engineering & Mining Journal, (March 1973), p. 167.

ORBA

A UNIT OF AMCA INTERNATIONAL CORPORATION

ONE GOTHIC PLAZA
FAIRFIELD, N. J. 07006
PHONE (201) 575-9560

Reprinted from February 2, 1980, issue of Skillings' Mining Review