Alternative Light Rail Transit Implementation Methods for Hennepin County, Minnesota

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The Comprehensive Light Rail Transit (LRT) System Plan for Hennepin County, Minnesota, defines a Stage 1 system, a 20-year system, a financial plan, and an implementation plan. The purpose of the implementation plan is to define the contractual relationship between the Hennepin County Regional Railroad Authority (HCRRA) and the suppliers of the LRT system, to define the system operating and maintenance responsibility, and to define the relationship between associated land development and the LRT system. The reason for investigating alternative implementation methods is that much interest exists in involving the private sector to the maximum extent, consistent with the public interest. LRT system implementation will include not only the construction and procurement of system facilities and equipment, but also the financing of this work. In addition, options may be available to involve construction and procurement contractors in the operation and maintenance of the system after it is built. Recent years have also seen great interest in coordinating land development with rail transit construction. In some instances, developers of adjacent land have participated in the financing of transit stations. This report defines the LRT system components, identifies and evaluates alternative implementation methods, and outlines conclusions on an approach to LRT system implementation.

THE TWIN CITIES OF Minneapolis and Saint Paul have analyzed the feasibility of fixed-guideway transit systems since 1968 when the Metropolitan Transit Commission was formed. To date, no system has been implemented. The general history includes the following events:

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- Late 1960s and early 1970s—studies resulted in a regional, preferred fixed-guideway system that was automated and used a 40-passenger vehicle;
- Mid-1970s—significant study of personal rapid transit was undertaken and studies of busways were completed;
- Late 1970s and early 1980s—feasibility studies of LRT were completed;
- Early 1980s—Minnesota legislature enabled counties to establish regional railroad authorities to implement light rail transit (LRT) systems;
- Mid-1980s—implementation studies of LRT were completed; and
- 1985–1987—the legislature prohibited any public agency from spending public monies on the planning or design of LRT.

These studies were all undertaken by a metropolitan or state unit of government. This governmental focus changed in 1987, when the Minnesota Legislature reinstituted the authority of regional railroad authorities to implement LRT. Thus, after many years of discussion, a single agency has the authority to proceed with LRT implementation in Hennepin County. The legislation required that the railroad authority prepare a comprehensive LRT system plan. The plan is based upon previous work and answers the following questions:

- Where will LRT services be provided within 20 years?
- What will the Stage 1 system include?
- What method will be used to implement the LRT system?
- How will the LRT system be financed?
- Who will operate the system?

POTENTIAL LRT ROUTES

Five corridors considered to have high potential for successful LRT implementation are being analyzed in the LRT system plan (see Figure 1). The Northwest Corridor connects downtown Minneapolis with the northwestern suburbs. A 1981 study of LRT feasibility in the region identified this corridor as a high priority. The University Connector would link downtown Minneapolis and the Minneapolis campus of the University of Minnesota, the third largest generator of transit trips in the region. This link was a portion of the corridor including downtown Minneapolis to downtown Saint Paul, which was studied in a recently completed alternatives analysis.

The Hiawatha Corridor would connect the downtown area with the airport and the proposed 10 million ft^2 of development known as the Mall of America in Bloomington. LRT was identified as the preferred transit alternative in a corridor Environmental Impact Statement (EIS) completed in 1985.

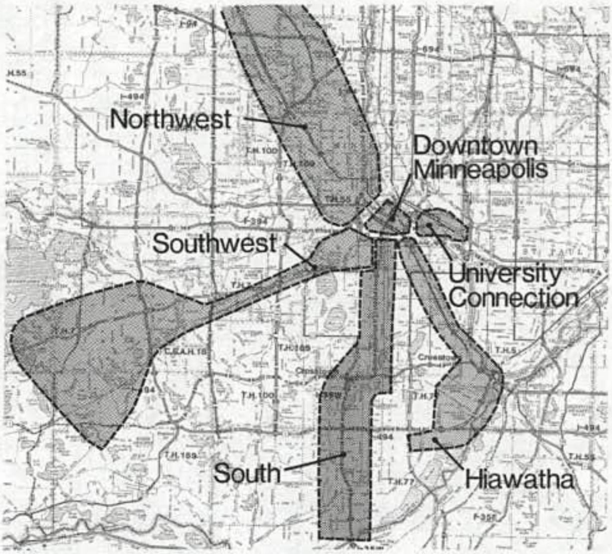

FIGURE 1 Study corridors.

The preferred roadway component of the corridor plan, a four-lane at-grade arterial, will go under construction in summer 1988. The South (I-35W) Corridor would connect south Minneapolis and the southern suburbs of Bloomington, Richfield, and Edina with downtown. Concurrent studies by the Minnesota Department of Transportation (MDOT) and the Metropolitan Council are assessing the need for I-35W highway and transit improvements in the corridor. The southwestern suburbs are connected to downtown via the abandoned Chicago and Northwestern Railroad right-of-way purchased by the Hennepin County Regional Railroad Authority in 1984. LRT was considered as an alternative during a draft and alternatives analysis of the University Avenue and Southwest Corridor.

In June 1988, the Hennepin County Regional Railroad Authority (HCRRA) adopted a Stage 1 system and a 20-year plan that are shown on Figures 2 and 3 and summarized in Table 1. The major conclusions of the plan are to proceed with implementation of an LRT service in the Twin Cities, to provide service in multiple corridors in Stage 1 versus service in a single corridor, and to construct a tunnel in the downtown area.

The financial plan for the Stage 1 system includes a countywide property tax, tax increment around stations, a portion of state sales tax on motor vehicles, and private sources. The county currently levies 0.75 mill, which raises \$7 million per year. In April 1988 the Minnesota Legislature appropriated \$4.17 million from the sales tax on motor vehicles for LRT "planning,

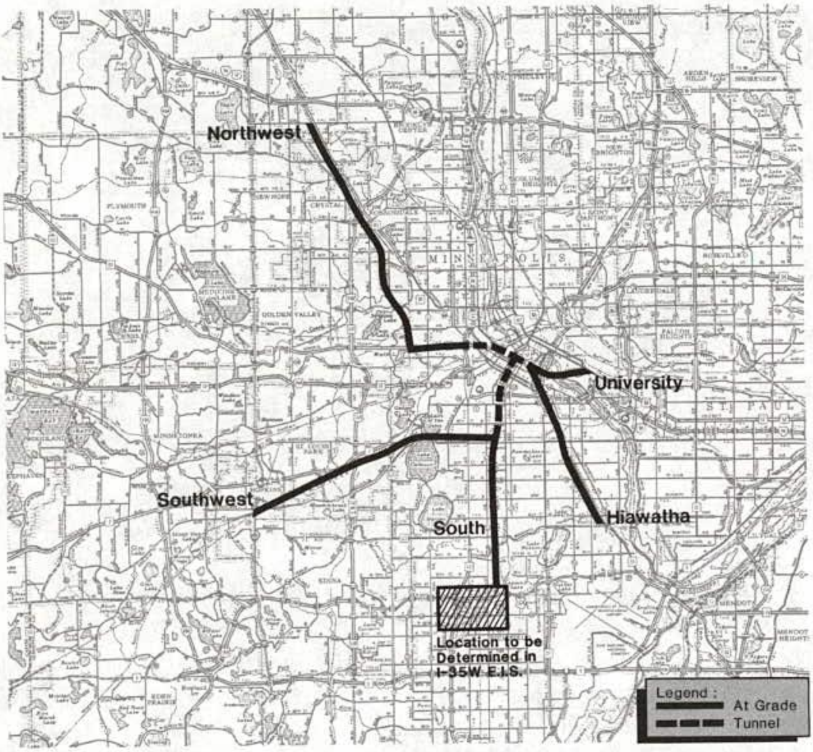

FIGURE 2 Stage 1 plan.

preliminary engineering, design, and construction" and also stated that the "funds appropriated for LRT should be considered as base level funding for presentation in the 1990–1991 biennial budget."

LRT PROJECT COMPONENTS

Figure 4 illustrates the major LRT system implementation components. LRT design and construction consists of the activities necessary to put the project's physical components in place: civil construction, procurement and installation of vehicles and their support systems, and construction of stations. The components include the following:

• Civil—the basic infrastructure of the system. For the purpose of simplification, this element involves preparation of the roadbed; all work below the subballast of the trackway, electrical subsystem foundations, underground conduit banks, drainage, subsurface treatment and grading; bridge structures;

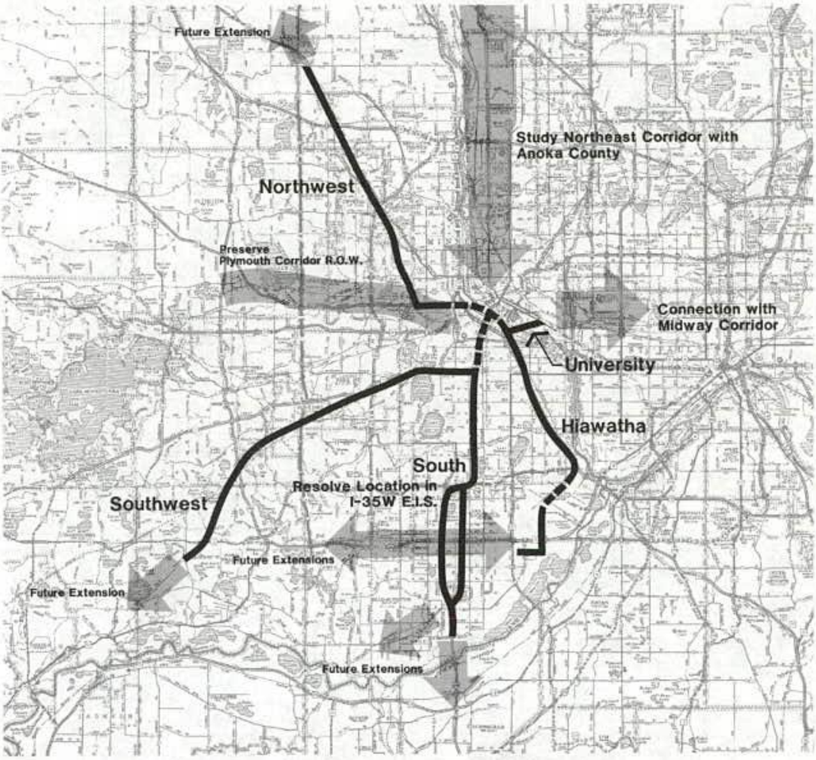

FIGURE 3 Twenty-year comprehensive LRT system plan.

street work; station footprints; and in the case of a subway section, tunnel construction.

• Systems—This element includes all facilities and equipment that are common throughout the system, i.e., light rail vehicles, track installation, electrification (power substations and overhead wires), signals, communication, fare collection, support equipment, and the central operations and maintenance facility.

• Stations—This involves station furnishings over and above the basic station footprint, including platforms and surface treatment finish work; lighting; furniture and amenities; electric power; shelters; heat; connections to roadways, public sidewalks and buildings; park-and-ride lots; elevators and escalators for any subway construction; and handicapped access.

Operations will commence upon the completion of design and construction. Public policy decisions (who will run the system and how) must be made prior to this event, an LRT operating structure defined and staff trained,

TABLE 1 CHARACTERISTICS OF RECOMMENDED 20-YEAR AND STAGE 1 PLANS

	TWENTY-YEAR PLAN			STAGE I PLAN		
SEGMENT	Length (Miles)	Capital Cost (1988 $ Million)	Daily Ridership Range Year 2010	Length (Miles)	Capital Cost (1988 $ Million)	Daily Ridership Range Year 2010
Downtown (Tunnel to 29th Street)	3.4	$138	–	3.4	$138	–
Northwest Corridor	12.0	139	19,600 - 25,500	9.0	114	18,000 - 23,500
Southwest Corridor	13.5	127	16,600 - 22,000	6.9	71	14,500 - 18,800
South Corridor	10.4	216	24,500 - 32,000	4.4	80	15,300 - 20,000
Hiawatha Corridor	10.0	145	17,300 - 22,500	3.9	34	13,000 - 17,000
University Connector	1.5	40	9,200 - 12,000	1.5	40	9,200 - 12,000
Yards and Shops	–	20	–	–	20	–
TOTAL	50.8	$825	87,200 - 114,000	29.1	$497	70,000 - 91,300

NOTE: The capital costs and patronage forecasts will be refined in Preliminary Engineering. The ridership forecasts are based on work reported in the Metropolitan Council report dated December 1986, "A Study of Potential Transit Capital Investments in Twin Cities Corridors" and the results of the Patronage Forecasting Peer Review Committee work.

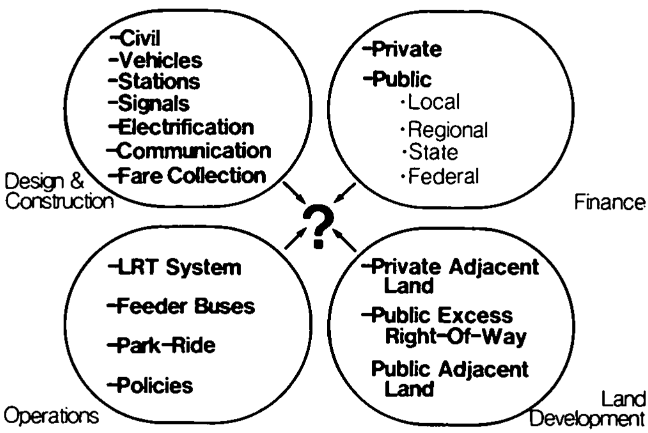

FIGURE 4 LRT project components.

and bus feeder services planned to coordinate service to the public. LRT will require that an organization be established, either within the structure of the existing transit agency or by a new operator, with rules and procedures appropriate to rail operations as distinct from the requirement of the present all-bus system. Personnel will be needed who possess specialized skills: transportation supervisory staff and train operators, security staff, vehicle maintenance personnel, and facilities maintainers.

Financing must be arranged from some combination of public and private sources to fund design and construction and ongoing operations. Related land development is likely to occur in the public right-of-way used by LRT as well as on adjacent private lands. Mechanisms can be implemented to capture for LRT system use a portion of the revenue that these new developments will create.

The issue addressed in this paper is how the above-defined LRT components should be related during system implementation and operation.

IMPLEMENTATION OPTIONS

LRT project implementation must efficiently coordinate the design, specification, procurement, and installation of equipment and construction of the LRT facilities. The objective of LRT project implementation is clear: on-time completion within budget with performance up to or exceeding the specification.

The major question is how to achieve this objective. To determine the best way to coordinate these facets of the implementation process, it is appropriate first to examine the various contracting methods as well as the roles and responsibilities of the implementers and then to match the contracting methods with the alternative implementation methods.

CONTRACTING METHODS

Several types of contracting methods may be used, each tailored to facilitate contractor performance of a particular set of construction, procurement, or furnishing and installation tasks. One-step competitive bidding (method A) is traditionally used when contract documents are clearly drawn and prospective contractors have a firm basis for their price proposals without significant latitude in interpretation. Advertisements solicit firm-price bids, after which award is made to the lowest responsive and responsible bidder.

Two-step competitive bidding (method B) is used when there is need to evaluate the bidders' approach to the project and their abilities to meet the stated objective. In these cases, the various prospective contractors have the latitude to approach the contract differently; and the owner reviews and selects the approach best suited to the original requirements before the contract award.

This process begins by advertising for technical proposals from potential contractors. Step 1 (which could be preceded by prequalifications, if desired) entails reviewing proposals (and possibly negotiating with the proposers separately to revise their technical proposals to meet the owner's needs). A limited number of responsive, responsible proposers judged to be capable of meeting the owner's needs are invited to submit prices. Step 2 makes the award to the lowest bidder.

Competitive negotiations (method C) are used when lowest price is not the only basis for award at the end of the evaluations. The process usually starts with an advertised request for letters of interest and qualifications. Proposals including technical approach and price are then requested from a screened list of qualified proposers. The main factors that are evaluated in the proposals are technical quality and price. Other factors, such as experience and performance history, may also be evaluated. Discussions and interviews are held separately with the proposers, as in method B, and continue until the proposers are asked to provide their best and final offers. Award is based on the highest-ranked proposals in terms of technical quality, price, and other prescribed factors.

ALTERNATIVE LRT IMPLEMENTATION METHODS

LRT system implementation will include not only the construction and procurement of system facilities and equipment, but also the financing of this work. In addition, options may be available to involve construction and procurement contractors in the operation and maintenance of the system after it is built. Recent years have also seen great interest in coordinating land development with rail transit construction. In some instances, developers of adjacent land have participated in the financing of transit stations.

The alternative methods of dividing the implementation work are discussed below. There are variations and hybrids of the methods shown, but those outlined constitute the basics for purposes of discussion.

Traditional

In the traditional method the project manager or engineer specifies the system elements (vehicles, electrification, signals, communications, fare collection, etc.) or components of the system elements (substation equipment, catenary network, track material, etc.) and issues separate detailed specifications for bid (see Figure 5). At the same time, the civil design is advanced to 100 percent drawings. Contracts are awarded for the system elements and components, and the contractors fabricate and furnish the equipment. The civil contract drawings are also issued for bid and awarded to low, responsible bidders; the contractors construct the LRT infrastructure. These construction contractors (or other contractors) could also install the electrification, signals, communication equipment, and fare collection. Upon completion, an operations contractor or a public agency operates the system.

Traditional contracting provides maximum control to the project owner, but limits the likelihood of obtaining contractor financial participation.

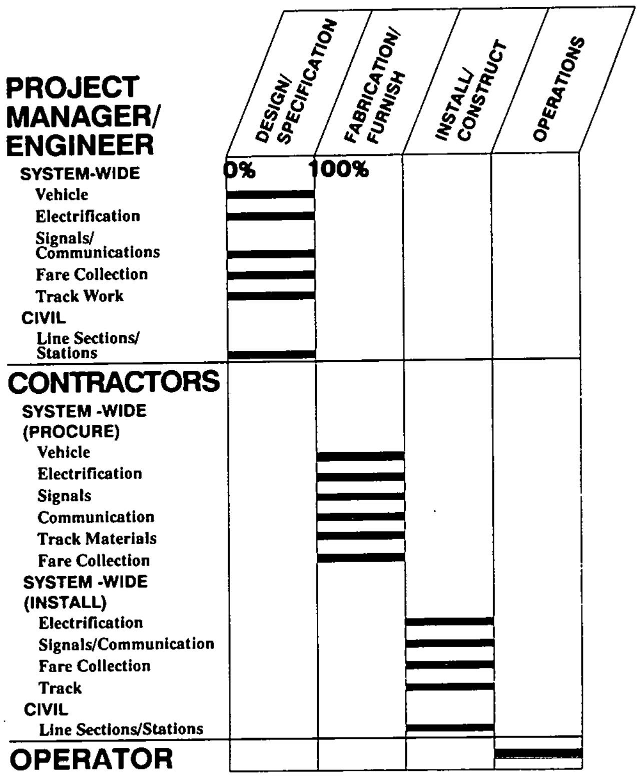

FIGURE 5 Traditional method.

Design/Build

In the design/build method, the project manager or engineer advances the design to the performance specification level in the case of the systems elements and to 30 percent in the case of the civil design (see Figure 6). The system elements each are awarded to contractors who design, furnish, and install the equipment. The 30 percent civil designs are issued for bid as design/build sections. Upon completion, an operations contractor or a public

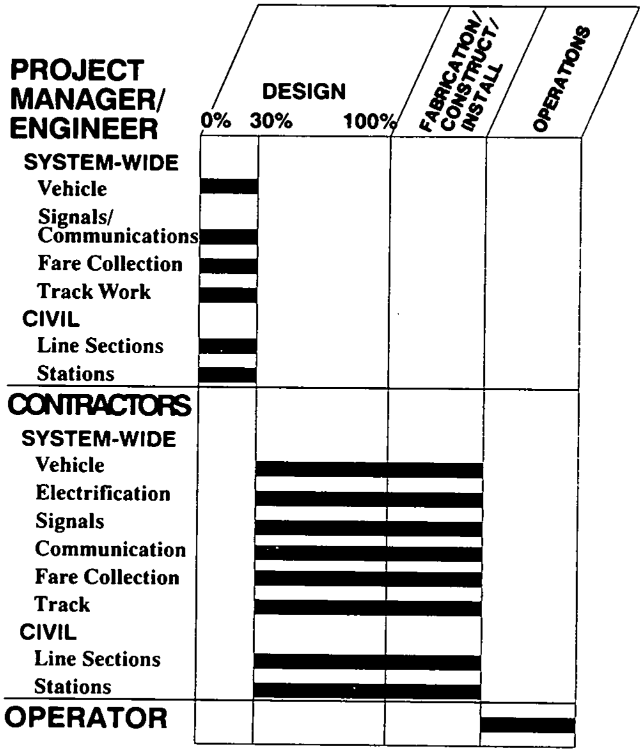

FIGURE 6 Design/build method.

agency operates the system; the operations decision is made independently of the design and construction.

The design/build method sacrifices a modest degree of owner control, but enables suppliers to tailor final design to their products rather than having to "reengineer" to the owner's exact specifications. Unless properly specified and managed, this approach can have the effect of limiting competition, thus affording an advantage in subsequent extensions to those firms successful in the initial stage.

Turnkey

In the turnkey method the project manager or engineer advances the design as would be done in the design/build method, but the performance specifications and 30 percent design are issued for competition as one package (see Figure 7). Having the project manager or engineer advance the design to 30 percent

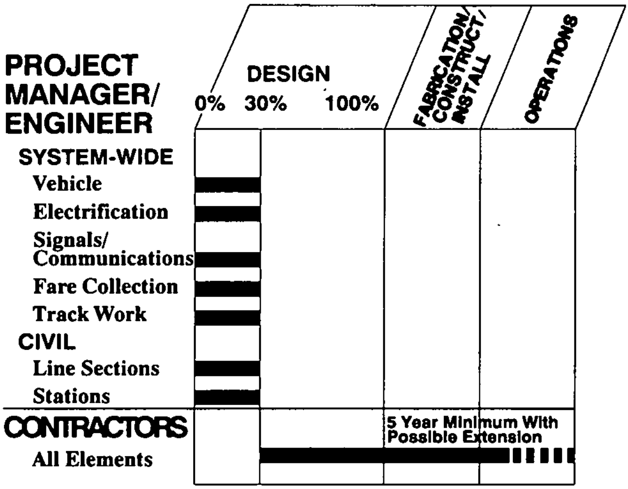

FIGURE 7 Turnkey method.

establishes the basic system parameters, allows for definitive cost estimation, and keeps the contingency margin reasonable.

The winning turnkey contractor completes the design in all areas and fabricates and furnishes the equipment at an agreed-upon price. The turnkey contractor also operates the system, at an agreed-upon price, for a prescribed period to ensure reliability. A minimum period of 5 years is usually suggested as a reasonable time period for problems to develop.

Turnkey further lessens owner control, but transfers responsibility for successful system operation to the turnkey contractor. Properly specified and managed, this approach focuses responsibility for cost and schedule performance, quality, and achievement of performance standards in a single entity. This removes many external interface-related claims.

Super Turnkey

The super turnkey method is the same as the turnkey approach except that the super turnkey contractor is also made responsible for partial or total system financing and is involved in the related land development. Financing might take the form of loans (e.g., vendor financing) or lease/buy-backs. There also could be a relationship of funding portions of the system, particularly at or around stations, through joint development.

The super turnkey approach makes the contractor responsible for financial and land development arrangements, but is likely to require that public agencies cede substantial control over the precise details of the technical and physical solution to the super turnkey contractor.

Contracting methods appropriate for each alternative implementation method are shown in Table 2.

TABLE 2 MATCHING ALTERNATIVE IMPLEMENTATION AND CONTRACTING METHODS

Alternative Implementation Method	Alternative Contracting Method
Traditional	One-step competitive bidding
Design/build	Two-step competitive bidding or competitive negotiations
Turnkey	Competitive negotiations
Super turnkey	Competitive negotiations

EVALUATION OF ALTERNATIVE IMPLEMENTATION METHODS

The evaluation of the applicability of the alternative implementation methods centers on the following criteria:

- Contractual, construction, and performance risk;
- Time schedule;
- Responsibility/accountability;
- Budget control/cost; and
- Quality.

Figure 8 presents a more detailed indication of how the various elements of LRT design and construction and operations fit together, and how they relate to options for public and private finance and development. Of 76 possible points of interaction, there are 32 "strong" and 25 "moderate" interrelationships.

These interrelations along with the above-defined criteria are used to reach conclusions. Although different metropolitan areas most likely will reach different answers about which implementation method to use, certain conclusions are reached on each of the implementation methods.

Civil

This element carries the greatest number of unknowns (e.g., soil condition variances), involves numerous third parties (utilities, railroads, and other

S Strong

M Moderate

N None

		LRT Design & Construction						Operations			Finance		Development	
		Vehicles	Civil	Stations	Communication	Signals	Electrification	LRT System	Feeder Bus	Public Policy	Public	Private	Public	Private
LRT Design & Construction	Vehicles													
	Civil	S												
	Stations	S	S											
	Communication	M	M	M										
	Signals	S	M	S	M									
	Electrification	S	M	M	M	S								
Operations	LRT System	S	S	S	M	S	M							
	Feeder Bus	N	M	S	N	N	N	S						
	Public Policy	S	S	S	N	M	M	S	S					
Finance	Public	M	M	S	M	M	M	S	M	S				
	Private	M	N	S	N	N	N	N	N	S	S			
Development	Public	N	M	S	N	N	N	S	M	S	S	M		
	Private	N	N	S	N	N	N	M	N	S	M	S	S	

FIGURE 8 Relationships among LRT system implementation components.

public jurisdictions), and also involves property acquisition. If a subway or tunnel is part of the LRT, the risks are even greater. With a 30 percent level of design completed by the owner, all potential contractors have to either complete a significant amount of additional engineering or include a significant contingency in any fixed-price bid.

The failure to make right-of-way available or to gain agreements with railroads has been a historic problem and a cause of many schedule delays on fixed-guideway projects.

The schedule delays have also resulted in increased costs caused by inflation. The owner will have to take this risk and establish a firm schedule for availability of right-of-way and clearance of all utilities with a turnkey or super turnkey approach. It does not appear feasible to use a turnkey or super turnkey approach for all portions of the civil component of an LRT system.

The traditional method affords the highest degree of control. Civil design can be paced and adjusted in accordance with systemwide design development, third party negotiations, and the overall project schedule. The owner or the owner's project manager or engineer can fast-track certain long-lead sections (e.g., bridges) and adjust implementation schedules on other sections as the need arises.

Systems

Systems procurement for furnish/install contracts for several North American LRT projects (e.g., Portland, Sacramento, San Jose) has successfully been implemented using the design/build approach. Some foreign projects (Istanbul, Tunis, Manila) are using the turnkey approach.

An important consideration is the integration of the various systems components with each other and with the civil components. Most integration problems encountered will fall into two categories: systems/civil coordination and the securing of approvals and permits from regulatory bodies. The owner's project manager or engineer must possess the requisite skills to ensure this coordination. The systems integration function is crucial to ensuring that an operable project is built. Under the design/build option, the owner, through the project manager or engineer, could perform the coordination between civil and systems and can perform the coordination among the systems components (vehicles, signals, etc.) as well. This will allow tighter control by the owner.

Regarding the turnkey approach, no single manufacturer can provide all of the systems components (see Table 3). Thus, a turnkey approach will require several companies to cooperate, organized either as a joint venture or as a prime contractor with subcontractors.

Some suppliers have expressed an interest in the turnkey approach based on experience with projects outside the United States. The "price" of some loss of control by the owner may be worth considering if the turnkey contractor is prepared to accept some of the cost and schedule risks, and if the contractor is made responsible for operations management of the system for an extended period of time beyond the normal 2-year warranty time (say at least 5 years overall).

There is some thought among transit engineers that the contractual link between the major components of building the system and operating it may bring additional benefits. By holding the contractor responsible for management of operations (local forces already in place will perform actual works under the turnkey contractor's management), there is a financial incentive not to allow operating costs to exceed initial projections. The contractor may be more careful to design equipment to reduce operating and maintenance costs, because equipment failures will reduce the contractor's profit. Conversely, reliable, maintainable equipment will reduce costs, hence increasing profit.

In conclusion, a design/build approach for systems components will apply contracting methods successfully used on other recent North American LRT

TABLE 3 REPRESENTATIVE LIST OF LRT SYSTEMS MANUFACTURERS BY AREA(S) OF SPECIALIZATION

Company	Home Country	Light Rail Vehicles		Track	Traction Power		Signals/Control		Communications			Maintenance		Access to
		Bodies	Mech/Elec	Matls	Substas	OH Equip	Rail	Traffic	Radios	Phones	CCTV	Tools	Vehicles	Financing
Alsthom	France	X	X							X				Y
Siemens	Germany		Proplsn		X	X	X[a]		X	X	X			Y
BBC	Switzerland		Proplsn		X									N
ASEA	Sweden		Proplsn		X									Y
NYAB	U.S.		Brakes											N
Ohio Brass	U.S.				X	X								N
GRS	U.S.							X						Y
WABCO	U.S.		Brakes				X							?
Bombardier	Canada	X												Y
Duewag	Germany	X												?
UTDC	Canada	X												Y
WECO	U.S.		X											Y
Central Power	U.S.				X									N
Hegenscheidt	Germany											X		N
Stanray	U.S.											X		N
Motorola	U.S.								X					N
Bethlehem Steel	U.S.			Rail										N
L.B. Foster	U.S.			Ties										N
Niedermeyer-Martin	U.S.			Ties										N
Sumitomo	Japan	X		Rail										Y
Breda	Italy	X												Y

[a]Designs not compatible with U.S. practice.

projects and allow tighter owner control. A turnkey approach, however, may offer additional benefits regarding risk transfer and operating responsibility, albeit at the price of reduced county control.

Stations

The most appropriate implementation method for stations depends upon whether or not adjacent development opportunities exist. Traditional contracts are most appropriate to construct those stations where no developer involvement will occur. This will ensure maximum county control and coordination with other stations.

Super turnkey contracts are suggested where stations can be provided (i.e., built and paid for) by developers as part of adjacent building projects. Such contracts must be drawn to ensure compliance with LRT functional requirements (e.g., platform dimensions, weather protection for waiting passengers, station utilities, etc.); but some latitude may be given to allow developers to coordinate station architectural appearance with their projects.

Related Land Development

Counties in the State of Minnesota have no control over local land use decisions. They do not zone property and they do not approve building and site plans. Therefore, Hennepin County needs to establish interjurisdictional agreements with the various municipalities in which LRT service is proposed. With this completed, the county (as LRT developer) and municipalities can proceed together to solicit land developer or property owner interest and coordinate the development of stations integrated with adjacent real estate projects as discussed above and other developments on private land adjacent to the LRT right-of-way.

CONCLUSIONS

On the basis of the above discussion, two alternative approaches are suggested for metropolitan areas to pursue for the implementation of LRT systems.

Alternative A would use the traditional method for the civil component and the station/land development where no developer interest exists (see Figure 9). A design/build approach would be used for the system elements. Super turnkey would be used for station development where developer interest does exist. This approach retains significant control and responsibility with the owner, but allows the demonstrated advantages of design/build for the system

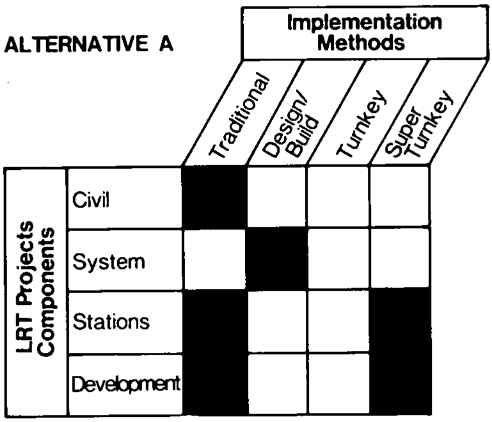

FIGURE 9 Alternative implementation methods for LRT project components (Alternative A).

elements. The role of the private sector relates to station construction and related land development. The objective would be to capture a portion of the increased value created by the presence of LRT.

Alternative B would result in maximum involvement of the private sector (see Figure 10). After the 30 percent design level the selected contractor would complete the design, build the system, operate the system, and be committed to capital contributions that relate to development around the stations or other innovative financing techniques. The contractor would be

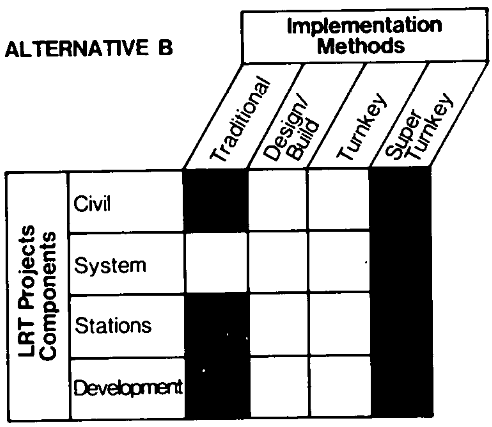

FIGURE 10 Alternative implementation methods for LRT project components (Alternative B).

selected on the following basis: financial capability, technical capability, management capability, and approach to "innovative" funding.

One of the problems with Alternative B is that no system has been completed using this approach. Many members of the private sector have recommended this approach, but to date it has not been used. One approach to giving Alternative B an opportunity without total commitment would be to follow the steps outlined below:

- Complete the preliminary engineering to the 30 percent level;
- While the engineering activities are being completed conduct the following tasks: prequalify super turnkey contractors and solicit technical approaches for innovative financing from the prequalified contractors; and
- If a proposal has substance, proceed with the super turnkey approach. If none of the prequalified proposers present "innovative" financing, continue with Alternative A.