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Factors Affecting Rail Car Costs

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Five major factors affect light and rapid rail car prices: (a) inflation, (b) market conditions, (c) technical aspects, (d) procurement and contractual practices, and (e) financial condition of the supply industry. Except for general inflation, most of these factors, particularly in the technical and contractual areas, are controllable to some degree by agencies purchasing rail equipment.

Many people in the transit industry and government are concerned about the dramatic increase in rail car prices. The light or rapid rail car that cost $150 000 to $200 000 in 1970, for example, may now cost $1 000 000. Two questions should be asked: (a) Have light and rapid rail car prices increased faster than the dramatic inflation of 1970-1981? and (b) Are rail car prices controllable? These questions are examined below.

INFLATION

Over the past decade, the transit industry, along with other sectors of the economy, has suffered from the effects of inflation. Figure 1 shows the escalation of rail transit car prices over the years. Inflation, as measured by the Consumer Price Index, has raised prices 250 percent since 1967. However, the General Rail Equipment Index shows rail car prices increasing more than 330 percent over this same period. Some of the increase in rail car prices may be attributable to general inflation, but almost half is clearly due to other factors.

In an inflationary period, where "time is money," a delay in any step of the procurement process has a negative effect (for the buyer) on bid prices. Costs of labor, materials, and overhead are rising constantly, and inflation will continue to take its toll on rail car costs.

MARKET CONDITIONS

Rail cars are largely custom designed for individual rail operators. Units are built in varying production runs, which have ranged in recent years from 14 units for the San Diego light rail to 754 units for the New York City Transit Authority rapid rail.

The market for light and rapid rail cars has been on the order of 300 to 400 cars per year. In terms of the domestic industry, where some items are produced in quantities of hundreds of thousands or millions, the rail car market is very small in quantity, but large in dollar cost per unit. The market has been characterized by a feast-or-famine cycle, with orders coming in bunches during certain periods. This irregularity of demand is reflected in prices, since production facilities and a core staff of skilled people are usually maintained in an active status even in periods of low production.

In terms of traditional economic supply and demand curves, large orders should result in significant competition among bidders. However, competition for small light rail car orders has been great, while competition for rapid rail car orders has been considerably less (see Table 1). The large capital requirements, perceived technical and contractual risks, and long delivery times associated with large procurements may have contributed to the decline in competition for large orders. On the other hand, foreign-based winners of light rail procurements, such as DuWag, continually build small production runs of relatively standardized equipment. (Procurements affected by the domestic assembly requirement of the UMTA Buy-America regulation for UMTA-funded procurements are not included in this group.) These firms are geared up for orders of 20 to 50 units and are therefore able to bid competitively for small orders, if the specifications do not require a new design. Recent light rail car procurements in San Diego, Buffalo, and Portland were based on in-production models.

The sequencing of orders has an effect on car prices. Recently, there has been a remarkable clustering of orders. In Chicago, Cleveland, Philadelphia, Atlanta, San Diego, Miami, Baltimore, Buffalo, Portland, and New York, transit agencies have all called for bids or placed orders in the past several years. This bunching of orders for different cars gives prime bidders and subcontractors minimal time to review specifications, seek cost estimates from vendors, and make the detailed technical analyses necessary to respond to bid documents. The time compression leads to added insurance costs for unknown conditions or risks.

Most orders are for a limited number of cars. The lack of assurance that there will be follow-on orders for similar cars contributes to high car prices. (In the past, a few orders have carried large options, such as CTA's order in 1978 for 300 rapid transit cars, with an option for an additional 300 cars.)

Bid timing and funding assurance also affect car prices. In an inflationary period, delays in the grant and multistage procurement process escalate costs. Funding should be timed so that local, state, and federal shares are all available at the appropriate time, and prime bidders must be given assurance that procurement will occur in a timely manner.

Figure 1. Cost of railcars compared with various economic indices.

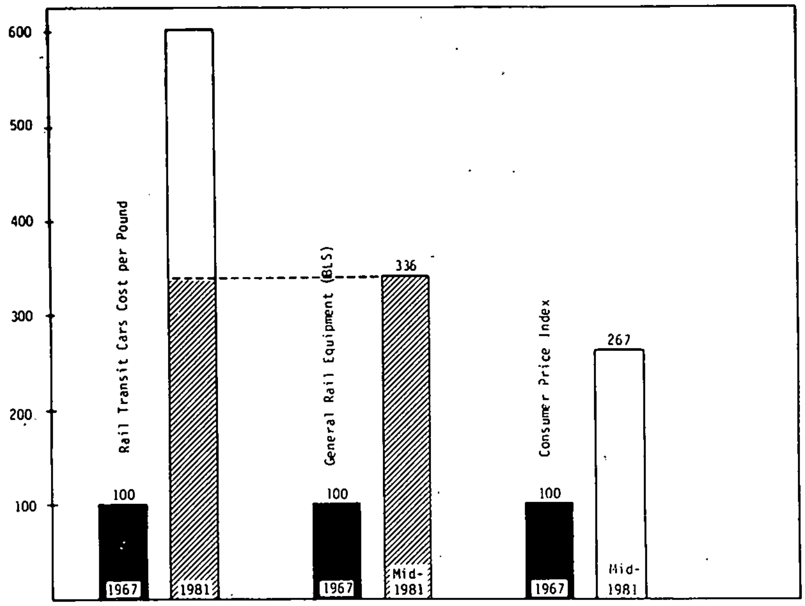


Table 1. Competitive rail car purchases.

Year	Authority	Number of Cars	Number of Bidders
Rapid Rail Cars:			
1970	PATH	46	3
1972	NYCTA	752	4
1972	WMATA	300	4
1974	CTA	100	2
1976	MARTA	100	2
1976	MBTA	190	2
1978	MDC/MTA	136/56	1
1978	CTA	300	3
1979	WMATA	94	3
1979	Philadelphia	125	4
Light Rail Cars:			
1973	MBTA/MUNI	230[a]	5
1977	GCRTA	48[a]	10
1979	SEPTA	141[a]	6
1980	NFTA	30[a]	9
1981	TRI-MET	26[a]	2

[a] Original order; not including option.

TECHNICAL ASPECTS

There is no single technical factor that determines car prices; rather, a number of factors, such as specification type (i.e., level of detail), car design, and degree of standardization, combine with the contractual terms and conditions to result in a final bid price.

Specification Type

Figure 2 shows car purchase prices for various systems over time, with weighted average by quantity. The trend line is an average for the population of all cars. The more sophisticated cars with some degree of automation and/or electronic propulsion are above this trend line. All these cars, except those for PATCO, were produced from performance-type specifications.

Figure 3 shows the escalation of car costs per pound for similar cars purchased by the same authority in different years. The lines on Figure 3 are remarkably parallel, which suggests that the car price escalation rates have been consistent over a large number of procurements.[1] This indicates that the factors causing price escalation are not specific to any one authority or any one car design, but have affected the whole industry uniformly.

Two specification types are used in rail car procurements: (a) performance and (b) detail or hardware. Performance specifications, the type preferred by car builders because of the greater design flexibility they allow, are generalized descriptions of the rail car to be purchased.

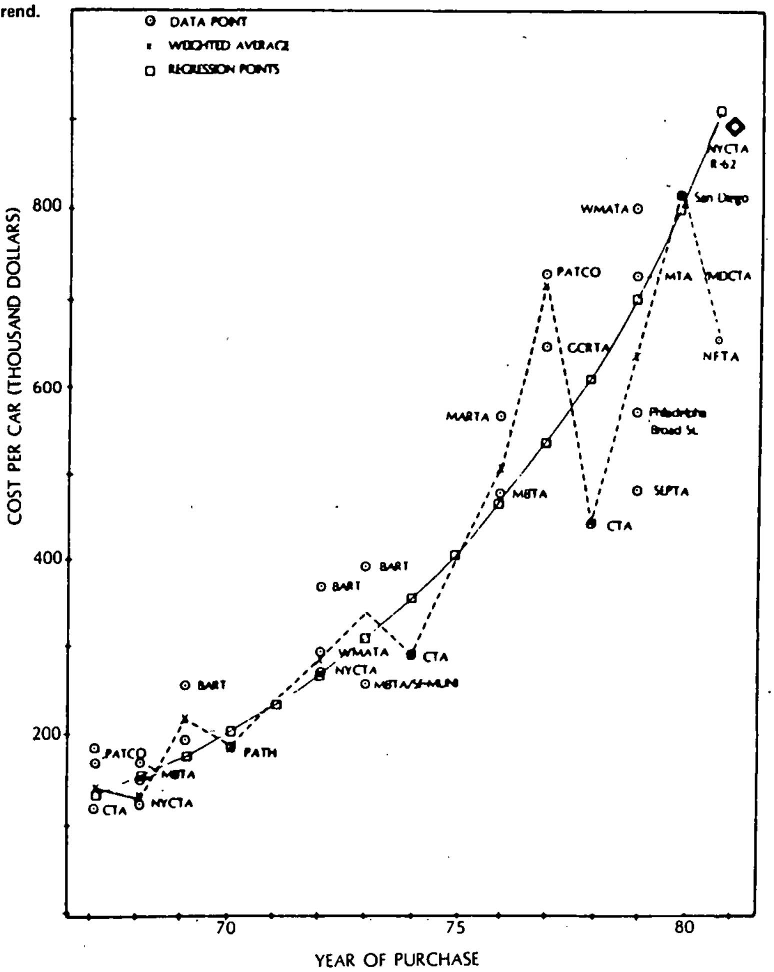


Figure 2. Rail transit car cost trend.

Sometimes performance specifications may be very short, providing only a minimal outline of a system's fixed facilities, to allow a car already in production to be offered. Performance specifications are frequently used for newer systems without lengthy operating experience. Detailed specifications, frequently used by older rapid rail systems, usually consist of specific hardware and component designs. They are most often used where new cars must be made compatible with existing cars.

Car Technical Details

In preparing technical specifications, a purchasing agency must make a number of trade-offs on technical features of the vehicle. Each of these technical features will have an impact on initial and operating costs. In a study of the Masschusetts Bay Transportation Authority/San Francisco Municipal Railway joint light rail car specifications, a number of technical and contractual changes were cited that could reduce the purchase price by approximately 10 percent on a potential 100-car order.[2] These changes included the following:

- Deleting plug doors and substituting folding doors,
- Simplifying the control system,
- Simplifying qualifications testing,
- Simplifying documentation requirements,
- Relaxing car body smoothness criteria, and
- Simplifying the articulation section.

Other technical details also have potential for affecting costs; cars could be designed with doors on one side versus both sides, with one cab versus two operating cabs, or as an articulated or a rigid unit.

The articulation joint and extra truck may add \$100 000 to the initial car cost. However, articulated cars may provide significant operating savings if fewer articulated cars can provide the same seating capacity as nonarticulated cars. Such technical trade-off decisions made during the specification development process optimize system performance and influence both initial and operating rail car costs.

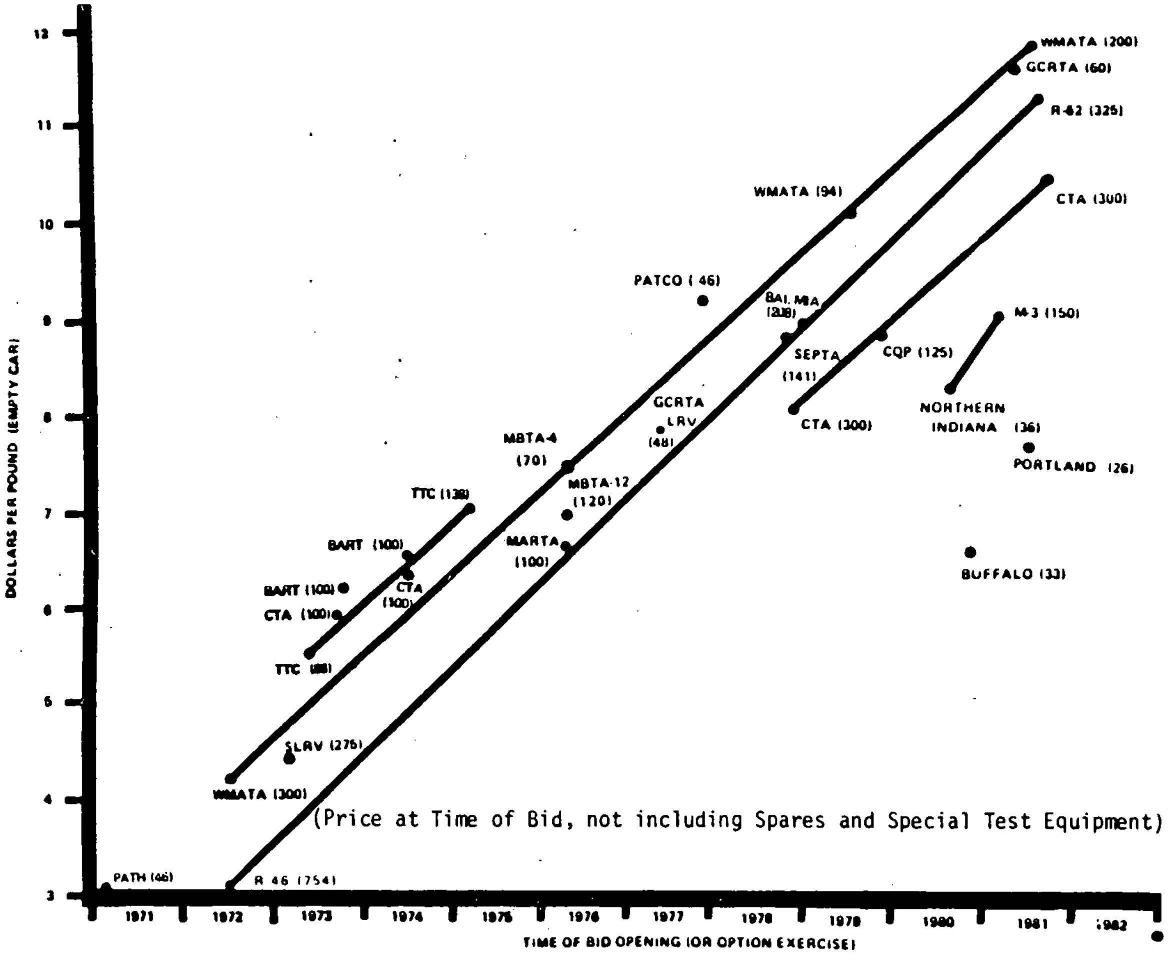
Standardization

Standardization is another important (and controversial) technical factor that has the potential to reduce car prices. However, in the past, light rail design has resisted standardization. As D.S. Hellewell concluded from an analysis of 16 light rail vehicle designs in 1977[3],

> It is remarkable . . . that in spite of attempts to lay down standards for new tramcars in several countries—notably West Germany—and the existence of so-called "standard" products from the small number of specialist tramcar builders, no true standard designs have emerged suitable for . . . light rail operation.

Certainly in the United States, no single design such as that for the PCC car of the 1930s has been adopted. However, it is increasingly clear from early light rail experience in Boston that equipment with proven reliability and operational experience is being specified by buyers of

Figure 3. Transit railcar procurements, 1971-1981.



light and rapid rail cars to ensure initial reliable operation.

Car prices reflect the degree of standardization at the subsystem, subsystem interface, and general performance levels. If standard products of several manufacturers can be used widely, not only will initial car order prices show benefits of price competition, but an assured market for replacement parts will benefit purchasers by making parts available at competitive prices. Standardization in the maintenance area will help stabilize or lower operating costs by reducing spare parts inventory, ordering lead times, and training time for maintenance personnel. Savings resulting from reduced inventory and lead time for parts reordering could be \$5.9 million per year.^{4} Unfortunately, with the exception of the Siemens-DuWag U-2 car used in San Diego, Calgary, and Edmonton, domestic light rail cars ordered recently (Portland, Buffalo, and Cleveland) are quite different in design and subsystem configuration. As a result, their unit prices vary widely: Cleveland, 48 LRVs (1977), \$645 000; Buffalo, 33 LRVs (1981) \$660 600; and Portland, 26 LRVs (1981), \$775 521. This amount does not include spare parts, special tools, and training, which, when included, add \$57 940 per car.

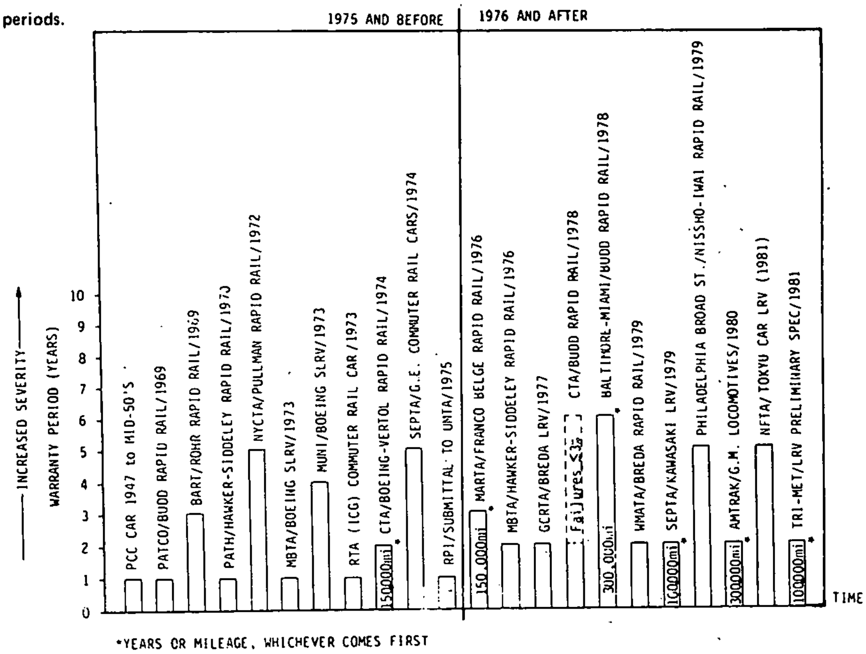
PROCUREMENT AND CONTRACTUAL PRACTICES

In the mid-1970s, the supply industry initiated a campaign against what were considered inequitable contractual terms and conditions offered on rail car bid documents. Suppliers believed that a number of clauses, notably those covering authority of the engineer, progress payments, escalation, guarantees, and indemnification, were weighted unfairly in favor of buyers. A dialogue with operators and suppliers conducted by UMTA in response to supplier complaints resulted in issuance of the Special Guidelines for Rail Transit Equipment Procurements in 1978. These procurement guidelines were intended to clarify and improve some of the more commonly used clauses in rail car contracts. Guaranty and warranty clauses, however, were not included in the special guidelines because of the difficulty, complexity, and controversy surrounding this important contractual area. (The terms guaranty and warranty have different legal meanings, but are frequently used interchangeably in the transit industry.) A study of warranty clauses (see Figure 4) performed for UMTA^{5} shows that warranty periods for transit and locomotive motors differ dramatically in time and/or mileage. There has been a noticeable trend toward increasing warranty periods in rail car procurements—which has resulted in increased bid prices.

It has been estimated that 2.5 percent of the car purchase price is for warranty and field support and that reliability requirements add another 1.8 percent.^{2} Thus, an estimated total of 4.5 percent of the car price is related to guaranty, warranty, and reliability contractual provisions. Such provisions are a necessary part of any equipment purchase, but careful structuring of these clauses may result in a modest cost reduction without a sacrifice in quality.

Clarity of items in contracts (such as definition of failure) has important cost implications. Unclear contractual language can lead to unproductive legal or administrative disputes and claims. Procurement practices

Figure 4. Propulsion motor warranty periods.



and contractual language are receiving increased attention in the transit industry as areas that directly affect car prices.

FINANCIAL CONDITIONS

Interest rates have a direct bearing on car costs. Although interest rates are not controllable, equitable progress payments can help builders meet interest payments. Timely payments are particularly important in the pre-production stages of a car order, when tooling is being ordered and parts stockpiled. Profit on previous orders is important to prime and subcontractors; a good experience on a past order will keep a company active and competitive in the future.

SUMMARY

There are five major factors that have an impact on car prices:

- Inflation,
- Market conditions,
- Technical aspects,
- Procurement and contractual practices, and
- Financial conditions.

Inflation and the financial condition of suppliers as it is affected by interest rates are the least controllable factors. But the other factors can be to some degree controlled. From Figure 1, it is clear that much of the escalation in rail transit car prices is not due to inflation, but rather to some combination of these other controllable factors. Figure 3 shows that price escalation is not a problem of only one authority or related to a single car design. The rise in cost is uniform: Every rail transit car purchase in the past 10 years has been affected to almost the same degree. If the factors driving noninflationary escalation are understood and controlled, significant cost savings can be realized on future rail car procurements.

Many persons with different professional expertise (attorneys, procurement specialists, engineers, operations specialists, maintenance directors, etc.), within and outside of a transit authority, are involved in preparing rail car specifications. Therefore, optimization of car design depends to some extent on "who's in charge." The large number of technical and operational trade-offs necessary in specification development will shape the rail car design, performance, and maintenance characteristics and will ultimately be reflected in initial and operating costs. Decisions on contractual provisions, particularly the guaranty and reliability provisions, will reflect the degree of risk in the car design and will be reflected in bid price through built-in insurance costs. In some cases, transit authorities have capitalized maintenance costs by using extended (or special) warranties.

The million-dollar rail car is now a fact of life. The extent to which future bid prices will be above or below that figure will be determined by how effectively the specification writer approaches the complex factors described in this paper.

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