

GREGORY L. THOMPSON earned a Master's in City and Regional Planning at the University of California at Berkeley in 1970 and over the next eleven years worked for the Edmonton Transit System, the Canadian Transport Commission, the City of Berkeley, and the San Diego Metropolitan Transit Development Board. He earned his doctorate in Social Science from the University of California at Irvine in 1987, spent the next year as a post-doctorate fellow at the Hagley Museum and Library, and has taught in the Department of Urban and Regional Planning at Florida State University ever since. He now holds the rank of professor. He wrote a book in transportation history (*The Passenger Train in the Motor Age: California's Rail and Bus Industry 1910-1940*. Columbus: Ohio State University Press, 1993), and numerous articles in contemporary public transportation policy.

Resumen

Este artículo aborda dos cuestiones: ¿Por qué surgió en Norteamérica el movimiento en pro del ferrocarril ligero, cuando hasta 1970 el transporte urbano había venido descendiendo precipitadamente y los tranvías habían desaparecido de forma prácticamente total? Ya en 2003, catorce regiones urbanas de Estados Unidos y Canadá, que en 1970 carecían de transporte urbano sobre carriles, habían abierto líneas de ferrocarril ligero. ¿Cuáles han sido los resultados? El artículo trata esta primera cuestión relatando la historia del nacimiento y desarrollo de la idea del ferrocarril ligero en Norteamérica desde la década de 1960 hasta la celebración, en 1975, del primer Congreso Nacional del Ferrocarril Ligero, y examinando también cómo se tomó la decisión de construir la primera línea de ferrocarril ligero en América del Norte (Edmonton, inaugurada en 1978) y la primera de Estados Unidos (la de San Diego, abierta en 1981). Las fuentes de información han sido, en gran medida, entrevistas celebradas con participantes importantes, así como documentos históricos. La segunda cuestión se analiza mediante la presentación de tendencias calculadas a partir de la base de datos de transporte urbano nacional, de la Federal Transit Administration.

Palabras clave: Tránsito; planificación; ferrocarril ligero; medio ambiente; Norteamérica.

Abstract

This paper addresses two questions. Why did the light rail movement arise in North America, when up to 1970 urban transit had been in precipitous decline and streetcars had all but disappeared? By 2003 14 urban regions in the U.S. and Canada that had no rail transit in 1970 had opened light rail transit lines. What have been the results? The paper addresses the first question by tracing the birth and development of the light rail idea in North America from the 1960s to the first National Light Rail Conference in 1975 and also by examining how decisions were made to build the first light rail line in North America (Edmonton, opened 1978) and the first in the United States (San Diego, opened 1981). Sources are largely interviews with important participants as well as historical documents. It examines the second question by presenting trends calculated from the National Transit Data Base of the Federal Transit Administration.

Key words: Transit; planning; light rail; environment; North America.

The birth of the Light Rail Movement in North America and its results

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1. Introducción

The historian of technology, Dr. Joseph Corn notes that Americans of the 19th and first half of the 20th centuries felt swept along in a relentless and uncontrollable current of technological change. Nonetheless they generally believed that the wild ride would end in a better future. The 1960s, however, saw optimism replaced with pessimism. Increasing environmental degradation led to a loss of confidence in uncontrolled technological progress, and this attitude in turn led to collective efforts to control the way in which technology unfolded¹. This paper argues that the light rail movement in the U.S. and Canada was one example of the resulting social activism. It examines the growth of the light rail idea and its adoption in Edmonton and San Diego. It concludes with reflections on the results.

2. The light rail idea

The attributes of light rail transit were recognized in North America at least a decade before the concept was branded. The U.S. transit consultant Mr. H. Dean Quinby followed the rebuilding of Germany's street-car systems during the 1950s and discerned two qualities that were emerging in most of the rebuildings. These two qualities appeared to Mr. Quinby to constitute the emergence of a new mode of transit, and he published his insights in *Traffic Quarterly*².

One of the attributes was capacity enhancement with emphasis on larger cars, operation of cars in trains, and much greater door capacity with new fare systems to make use of that capacity. The result was that for the first time surface transit could engorge and disgorge large volumes of passengers at intermediate stops

¹ Corn (1987), pp. 1-2.

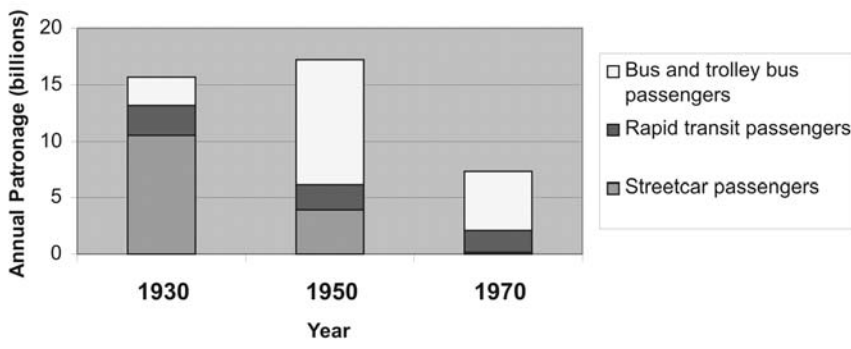
² Quinby (1962), pp. 242-259.

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quickly. The other attribute was speed enhancement, achieved through traffic engineering and light infrastructure investments, with short applications of heavy infrastructure investment in critical areas. What particularly impressed Mr. Quinby was the effort to achieve both attributes at low cost. Rapid transit lines, of course, already had both attributes, but they were prohibitively costly. As Mr. Quinby saw it, the goal of the streetcar rebuilding was to bring the qualities that long had been the sole province of rapid transit to surface-running transit, thus making the attributes much more widely available to the public.

These ideas appealed to some who wished to reverse the long decline of transit, summarized in Figure 1. From 1930 transit managers replaced streetcars with buses to cut costs. Buses were not popular, however. By 1970 the public's use of them was plummeting. Had traditional streetcars been retained, they probably would not have done much better. Interestingly, though, rapid transit patronage was comparatively resilient to the auto onslaught. For those who wanted to preserve public transit use, rapid transit seemed like an obvious choice. Unfortunately, it was too costly to be adopted widely. What, however, if one could obtain many of the characteristics of rapid transit at a fraction of the cost? The goal of what became known as light rail transit after 1972 was to do just that. It was to be every city's rapid transit.

Figure 1. U.S. Transit Patronage 1930, 1950, 1970



Source: Saltman (1992), p. 31.

The appeal of such ideas spread through the 1960s even as streetcar lines and the last of the interurbans continued to be abandoned in cities such as St. Louis, Los Angeles, Chicago, Baltimore, Pittsburgh, Philadelphia, and Washington, D.C., and U.S. transit use continued to plummet. An additional professional article defining the ideas of what became light rail appeared in 1965, and an English publication, *Modern Tramways*, kept North American readers up to date with the latest northern European developments³. At the same time increasing numbers of

³ Adams (1965), pp. 443-457.

North Americans were traveling to northern Europe, including some who were interested in transit revival. The difference between what they were experiencing at home and what they saw in northern Europe was stunning and galvanizing.

An American consultant, Mr. Stewart Taylor, advanced the movement considerably at the end of the 1960s by linking the ideas of what became light rail with federal government policy toward road construction. Up to this time federal road policy encouraged the building of large-scale interstate express highways through dense cities while denying capital and operating grants to mostly privately-owned transit systems. Federal policy, which was based on the idea of providing facilities in response to consumer demand (though no pri-cing was involved), led in Mr. Taylor's view toward transit decline, urban blight, suburban sprawl, and general environmental and social degradation. A change in federal policy to support what became known as the light rail idea would correct urban ills, according to Mr. Taylor. To publicize these views, Mr. Taylor visited various German transit properties and their managements in 1969, and he set his ideas forth in what became an influential article.⁴ Mr. Taylor was from an important Washington family and had been comfortable in the presence of power since his youth. He wrote the article to appeal to those in power. A conservative think tank, the Heritage Foundation reprinted it, and it was reported on by new media for several years thereafter⁵.

Mr. Taylor's efforts occurred when federal transportation policy was in a state of flux. The Highway Act of 1962 established the beginnings of the metropolitan planning organization (MPO) planning process. The MPO planning process was strengthened with the Highway Act of 1973. In the early 1970s newly established MPOs around the U.S. were undertaking studies of regional rapid transit systems that augmented regional freeway systems. The Urban Mass Transit Act of 1964 established what later became known as the Urban Mass Transportation Administration, which at the end of the decade was placed in the newly-created Department of Transportation, a new department in the president's cabinet. The 1964 act provided federal funds for local governments to use to buy private bus systems, to buy new buses, and to construct new garages. Municipal and regional transit authorities took control of most U.S. private transit systems during this period. The Urban Mass Transportation Assistance Act of 1970 provided \$3.1 billion to mass transit systems over a five year period, some of it intended for renewal of existing rapid transit systems, but much of it intended for new start rapid transit systems. It was apparent from the beginning, however, that claims for such funds would outstrip supply by several-fold⁶.

In 1972 several staff members in UMTA who advocated the concept that became known as light rail conferred with several like-minded consultants about branding the idea. That is when the moniker, "light rail," came into existence. The term "light" referred neither to the rail nor to the vehicle but to the infrastructure,

⁴ Taylor (1970), pp. 513-529.

⁵ Interview by author with Mr. Stewart Taylor, Washington, D.C., 14 June 2002.

⁶ Black (1995), p. 41-67; Interview by author with Mr. Kenneth Orski, Washington, D.C., 14 June 2002.

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when compared to rapid transit, or “heavy rail.” UMTA retained Dr. Vukan Vuchic, a Professor of Civil Engineering and Planning at the University of Pennsylvania, to write a report that summarized light rail development in Europe along with the status of subway-surface streetcar operation in the United States. Dr. Vuchic had been collaborating with Dr. Friedrich Lehner, the most influential of Germany’s transit engineers and who developed many of the ideas associated with light rail. Dr. Vuchic also was a confidant of Mr. Dean Quinby⁷. At the time Boston and Philadelphia had old streetcar subways in their downtowns. Outside of the downtowns, streetcars in those cities ran in the streets or in the medians of streets. The Bay Area Rapid Transit (BART) project in the San Francisco Bay Area also was nearing completion, and in addition to regional rapid transit, it created a downtown subway bore in San Francisco which might be used by a new local rapid transit line or, alternatively, by the few remaining local streetcars. A heated political fight in the late 1960s in which both Mr. Quinby and Dr. Vuchic figured (Mr. Quinby clandestinely; Dr. Vuchic openly), resulted in a decision to put the streetcars in the subway. The streetcars still would operate on the surface in the inner suburbs. The Vuchic report provided a state-of-the art benchmark for future progress⁸.

UMTA’s first effort at promoting light rail was to create specifications for a standard light rail vehicle (SRLV) that could be used for all light rail applications. The immediate need was to replace PCC streetcars in San Francisco and Boston. According to Mr. Robert Abrams, who administered UMTA’s capital grants program at the time, UMTA wanted to reduce the costs of light rail vehicles by creating an off-the-shelf model that all applicants for federal funds to build or refurbish light rail lines would be required to use. Unfortunately, the initiative failed. The performance specifications were the size of a city phone book, and only one company bid on them. The company was Boeing Vertol, a military helicopter manufacturer in Philadelphia. The part of the Boeing Vertol order that went to Boston in 1976 was plagued with problems. The cars that went to San Francisco fared somewhat better, but they still required an inordinate maintenance effort to keep them running. To Mr. Abrams, the Standard Light Rail Vehicle program turned into a fiasco, but it advanced awareness of light rail technology and its possible applicability to U.S. transit systems⁹.

Between 1974 and 1976 a new UMTA Associate Administrator for Policy and Programs, Mr. Kenneth Orski advanced the light rail movement considerably by changing its focus from re-equipping old streetcar systems to building entirely new systems. Mr. Orski, a lawyer trained at Harvard, joined General Dynamics in 1956, and during his twelve years there examined peacetime markets that the company might pursue. Despite the declining fortunes of mass transit, Mr. Orski

⁷ Interview by author with Dr. Vukan Vuchic, Philadelphia, 13 June 2002.

⁸ Interview by author with Dr. Vukan Vuchic, Philadelphia, 13 June 2002; interview by author with Mr. Jeffrey Mora, Washington, D.C., 10 June 2002.

⁹ Interview by author with Mr. Robert Abrams, Washington, D.C., 10 June 2002.

foresaw a sizeable market in rapid transit rolling stock that would be necessary to restore U.S. urban areas. Between 1968 and 1974 Mr. Orski worked for the Organization for Economic Cooperation and Development (OECD) in Brussels, where he focused on multilateral cooperation on transportation and urban development. That experience exposed Mr. Orski to the concept of light rail, which appealed to him. Shortly after assuming his UMTA role in early 1974, Mr. Orski circulated an internal memo calling for UMTA to require a planning process, ultimately known as alternatives analysis, for regions applying for federal funds to build new rail systems. One alternative that was to be given serious consideration was light rail transit, which was oriented to many of the same objectives as rapid transit but at lower cost. Mr. Orski issued a second internal memo in early 1974 suggesting that UMTA sponsor a national light rail conference to get the word out to planning bodies throughout the United States about the possibilities of light rail, which henceforth had to be considered in alternatives analysis¹⁰.

Mr. Orski approached the Transportation Research Board (TRB) to co-sponsor the light rail conference. In 1972 the then Highway Research Board (HRB) held a retreat in New Hampshire to discuss the growing federal role in transit and whether the HRB committee system should reflect that role. Following the conference HRB changed its name and established a new public transportation section with four committees and assigned Mr. William Campbell Graeb to staff the new transit committees. Mr. Graeb was originally from Bern, Switzerland, but he was trained as a civil engineer in the U.S., and had worked in highway planning for the District of Columbia before joining HRB in 1968. Mr. Graeb retained an interest in trams from his youth in Bern, however, and he was very interested in the light concept when he first heard of it. When TRB responded enthusiastically to Mr. Orski's request, Mr. Graeb was the logical person to handle the logistics of the conference¹¹.

The other logical body to co-sponsor the conference was the American Public Transit Association (APTA), but Mr. Graeb said there was serious internal division within APTA over whether the organization should be associated with light rail. There was very strong opposition from APTA members associated with rapid transit systems. Mr. Graeb did not know why the rail transit people were opposed but speculated that they did not want potential government money for rail rapid transit diverted to new light rail systems. Neither Mr. Graeb nor Dr. Vuchic mentioned it, and I did not bring it up in the interviews because I did not know it at the time, but by 1977 the president of APTA was Mr. Thomas O. Prior, General Manager of the San Diego Transit Corporation and a bitter foe of Senator James R. Mills, the major proponent for light rail transit in San Diego. Mr. Orski wanted Senator Mills to be featured prominently in the conference. Whether Mr. Prior was president of APTA in 1975 I do not know, but if not he likely would have been an important member of APTA. Ultimately, APTA decided to allow its name to be

¹⁰ Interview by author with Mr. Kenneth Orski, Washington, D.C., 14 June 2002.

¹¹ Interview by author with Mr. William Campbell Graeb, Washington, D.C., 11 June 2002.

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used as a co-sponsor, but only reluctantly, according to both Mr. Graeb and Dr. Vuchic¹².

The National Conference on Light Rail took place in Philadelphia in June 1975, with approximately 300 people registered, about double the number that Graeb and other organizers anticipated. The committee that planned it included Dr. Vukan Vuchic, Mr. Jeffrey Mora, Mr. Donald Touton, Mr. Joseph Sillien, Mr. William Morris, and several others. Mr. Stewart Taylor chaired it. Upon completion of the conference, Mr. Orski had UMTA retain a consulting firm to prepare a state-of-the art review of light rail transit in Europe and North America¹³. A second conference was held in Boston two years later, and national light rail conferences sponsored jointly by TRB and APTA have been held every three to five years since then¹⁴.

3. Adoption

The first region to adopt light rail in North America was Edmonton, whose first line opened in 1978. Calgary and San Diego opened their first lines in 1981. Decision-making leading to the first three light rail starts was not influenced much by the light rail conference of 1975, but it was influenced by many of the same forces that led to the first national light rail conference. On the other hand, decision-making leading to the second wave of light rail openings, in Portland, San Jose, Buffalo, and Sacramento, was heavily swayed by the first national light rail conference. I am in the process of researching light rail adoption and its consequences in these cities, with research most advanced for Edmonton and San Diego. At this point I will briefly summarize factors influencing light rail adoption in Edmonton and San Diego and their relationship to the North American light rail movement.

3.1. Edmonton

Edmonton had a municipally owned transit system dating from about 1909, which was managed by a cadre of professionally schooled engineers at least in later years. The general manager from 1949 to 1973 was an electrical engineer, Mr. Donald L. MacDonald whose first major task was to replace the antiquated streetcar system with trolley buses circa 1949-51. Because of the discovery of oil in nearby Leduc in 1947, the city's population grew from about 150,000 in 1950 to about 500,000 in 1970, and Mr. MacDonald strove to expand the transit system

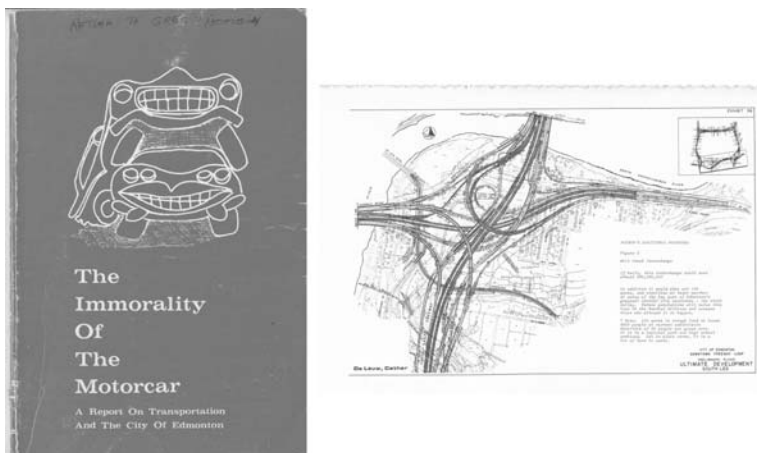
¹²Interview by author with Mr. William Campbell Graeb, Washington, D.C., 11 June 2002; interview by author with Dr. Vukan Vuchic, Philadelphia, 13 June 2002; interview by author with Mr. Kenneth Orski, Washington, D.C., 14 June 2002.

¹³ Diamant, *et al.* (1976).

¹⁴ Interview by author with Mr. William Campbell Graeb, Washington, D.C., 11 June 2002; interview by author with Mr. Jeffrey Mora, Washington, D.C., 10 June 2002; interview by author with Mr. Kenneth Orski, Washington, D.C., 14 June 2002.

to match the growth of the city. Professor John J. Bakker, a civil engineering professor at the University of Alberta who gained experience in the planning and operation of timed transfer bus systems in German-occupied Netherlands during World War II, aided Mr. MacDonald with this effort. During the 1960s Mr. MacDonald and Professor Bakker developed a long-range strategy of serving the downtown with rapid transit that was integrated with a region-wide timed transfer bus system¹⁵. Although they persuaded city council to approve the construction of a small rapid transit system in 1968, the realization that fares could not support its construction caused council to withdraw its support in 1970¹⁶. The city engineering department then asked council to approve the construction of a freeway ring encircling the downtown from which radials would extend to the suburbs. The proposal led to a revolt by community groups, which researched freeway revolts in Toronto and the United States and documented urban destruction that would ensue from the Edmonton freeway proposal, known as the Metropolitan Edmonton Transportation Study, or METS plan. The group published its findings in a little red book called, *The Immorality of the Motor Car* and successfully lobbied city council to scrap the freeway plan in 1971 (Figure 2)¹⁷.

Figure 2. Immorality of the Motorcar, Cover and Page Showing Urban Destruction Wrought by Freeway



Source: From author's collection.

¹⁵ Interview by author with Professor Emeritus John J. Bakker, by phone to Eagle Bay British Columbia, 14 August 2002.

¹⁶ Interview by author with Mr. Jaswant Kooner, Del Mar, California, 22 July 2002.

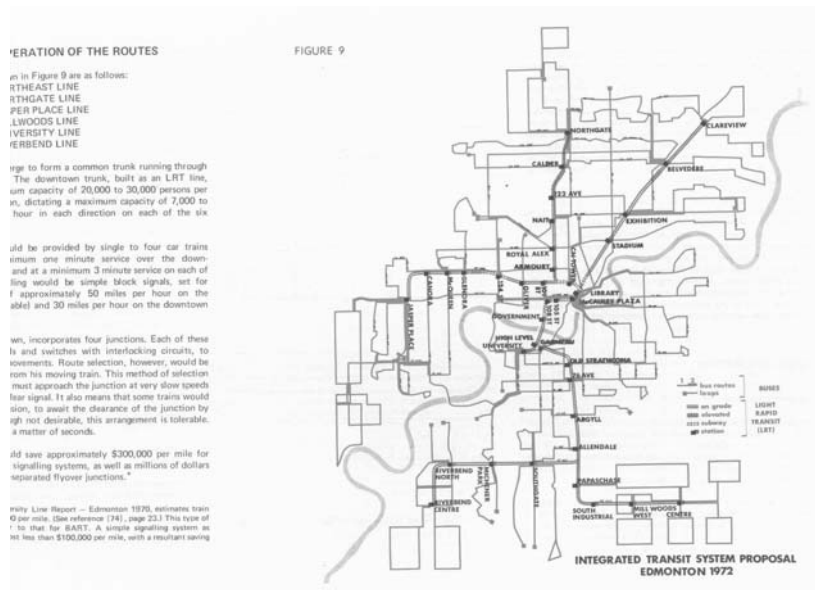
¹⁷ Interview by author with Mr. Jaswant Kooner, Del Mar, California, 22 July 2002; Interview by author with Professor Peter Boothroyd by phone to Vancouver, British Columbia, 16 August 2002.

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The group, called the Practicum on Community Analysis, then turned its attention to light rail, having been persuaded of its efficacy by articles in *Modern Tramways*, Mr. Dean Quinby's and Mr. Stewart Taylor's articles in *Traffic Quarterly*, and visits to German, Dutch, Swedish, and Swiss light rail systems. In 1972 it published, *Light Rapid Transit, the (Immediate) Answer for Edmonton*. This tract explained the light rail concept in Europe and showing how it could be applied to Edmonton. The cover featured a drawing of a Frankfurt U2 car.

A particularly important aspect of the practicum's message was that light rail should be thought of one element of a regional transit network, most of which would be operated by buses. If the bus system were restructured into a multi-destination network, in contrast to a CBD-oriented system, certain links would carry extraordinary traffic. These were the links to be operated with light rail. This was a major change in thinking from the concept of light rail as an independent line running from the suburbs to the downtown, which characterized the light rail movement elsewhere. The idea derived in part from Mr. MacDonald's and Professor Bakker's earlier integrated rapid transit and regional bus plans and in part from the practicum's own reasoning. Figure 3 taken from *Light Rail Transit, the (Immediate) Answer for Edmonton* illustrates the practicum's thinking in this regard.

Figure 3. Page from *Light Rapid Transit* showing light rail as part of regional transit network



Source: From author's collection.

Nothing further happened until the 1973 energy crisis filled Alberta provincial coffers with royalties. Both Mr. MacDonald and his counterpart in Calgary, Mr. William Kuyt were known and respected by the new premier of Alberta, Mr. Peter Lougheed, who diverted funds to new accounts opened for both Edmonton and Calgary to support the construction of light rapid transit for those cities. This led Edmonton City Council to approve light rail construction, using DuWag U-2 cars identical to those that were placed into operation in Frankfurt am Main in Germany in 1968. Calgary City Council followed a couple of years later, using the same type of car (but creating a very different type of infrastructure over which to operate them)¹⁸. Both cities had looked widely for cars and could find no interest on the part of U.S., Canadian, Dutch, or English manufacturers in supplying small orders. (Edmonton's was for 14 cars; Calgary's was for 25 cars.) That was until DuWag, the manufacturer of the the U2 car, was found. Professor Bakker recalls DuWag asking, "How many cars do you want? Two, three, six?"¹⁹.

3.2. San Diego

San Diego was the first U.S. region to adopt a new light rail line. Planning for rail transit in San Diego originated in the region's metropolitan planning organization, then called the Comprehensive Planning Organization (CPO). CPO's executive director, Mr. Richard Huff and his assistant, Mr. Kenneth Sulzer had been recruited in the mid-1960s from the National Capital Planning Commission (NCPC) in Washington, D.C., and CPO's first regional plan reflected ideas contained in the NCPC plan. The San Diego plan featured 59 miles of radial regional heavy rapid transit lines focused on the central business district. The rapid transit system was to be supported by dense land use development. Low density development was to separate the high density rail transit fingers. Approximately 2000 feeder buses would operate in addition to trains. At the time the San Diego Transit Corporation operated about 250 buses. Prepared pursuant to national transit legislation of the early 1970s that allocated several billion dollars for the construction of new rail rapid transit systems, the CPO plan was released in 1974²⁰.

The president pro tem of the California State Senate, Senator James R. Mills represented San Diego and favored transit development, having carried two important transit funding bills that enable expansion of the state's transit industry. He believed that the CPO plan was far too rich for the San Diego tax payer, however, and having been reading *Modern Tramways* for a couple of years and ha-

¹⁸ Interview by author with Mr. William Kuyt, by phone to Calgary, Alberta, 13 August 2002; Interview by author with Mr. John Schnablegger, by phone to Vancouver, British Columbia, 20 August 2002; Interview by author with Professor Emeritus J. J. Bakker by phone to Eagle Bay, British Columbia, 14 August 2002.

¹⁹ Interview by author with Professor Emeritus J. J. Bakker by phone to Eagle Bay, British Columbia, 14 August 2002.

²⁰ Interview by author with Mr. Kenneth Sulzer, San Diego, 16 July 2002; Interview by author with Mr. Jaswant Kooner, Del Mar, California, 22 July 2002.

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ving been in touch with Mr. Kenneth Orski, Senator Mills advocated light rail development for San Diego. Rebuffed by both CPO and earlier by the San Diego Transit's Mr. Thomas O. Prior, Senator Mills turned to the San Diego County Board of Supervisors for assistance²¹. The board authorized its assistant county engineer and highway designer, Mr. Rudy Massman, to investigate the feasibility of light rail in CPO's highest priority corridor. Mr. Massman put together a small staff of road designers, costers, and a transit engineer, Mr. Jaswant Kooner who had worked under Mr. MacDonald and Professor Bakker. Mr. Massman concluded that a high performance light rail line could be built at low cost from downtown San Diego to the south. In the second part of the study, which included the author, another protégé of Mr. MacDonald and Professor Bakker, Mr. Massman concluded that a regional light rail system was feasible and would serve the region effectively if it were the central part of a reconfigured bus system that allowed multi-destination bus service in the region. On the basis of the study, Senator Mills introduced and carried state legislation that created the San Diego Metropolitan Transit Development Board with power and funding to carry out the vision put forward by Mr. Massman. Much of the power of MTDB was gained at the expense of both SDTC and CPO, and according to Senator Mills' aide Mr. Arthur Bauer, UMTA staffers attempted unsuccessfully to decertify the San Diego region as a consequence of its passage²².

Under the direction of Mr. Robert Nelson, who previously had been deputy general manager in charge of finance for the San Francisco Bay Area Rapid Transit District (BARTD) and who held a similar position later at the Metropolitan Atlanta Regional Transit Authority (MARTA), MTDB crafted a plan for constructing light rail within the constraints of existing state and local funding sources. The San Diego proposal called for the use of DuWag U2 cars almost identical to those about to go into operation in Edmonton. MTDB's task was made easier in August 1976 when Tropical Storm Kathleen washed out part of the San Diego & Arizona Eastern Railway, which coincidentally traversed the desired corridor. The SD&AE's owner, the Southern Pacific Company was amenable to talking about selling the railroad to MTDB. In 1978 San Diego Transit threatened to reduce bus service if MTDB went ahead with its plans, because it said that there was not enough money in the region to operate both the bus and rail service. For the previous three years San Diego Transit's unit costs escalated at about 15% per year, more than double the rate of inflation. Mr. Nelson countered that if San Diego Transit's unit costs could be frozen for two years and then allowed to grow at 5.5% per year for 15 years, the region not only could afford both the existing bus service and light rail, but the amount of transit service operated in the region could be doubled over the next 15 years. MTDB's Service Concept Element

²¹ Interview by author with Senator James R. Mills, Coronado, California, 17 July 2002.

²² Interview by author with Mr. Rudy Massman by phone to San Diego, 15 August 2002; Interview by author with Mr. Arthur Bauer, Sacramento, 6 August 2002; Interview by author with Mr. Jaswant Kooner, Del Mar, California, 22 July 2002; Interview by author with Mr. Kenneth Sulzer, San Diego, 16 July 2002.

(Figure 4) reflected Nelson's concept for service expansion in the region²³.

The Service Concept Element showed a network of red regional semi-express transit lines that were intended to interconnect the major destinations in the San Diego region. This was a destination-based transit network in a region where the CBD (called Centre City) accounted for less than 10 percent of trip destinations. None of the red lines then existed. According to the Service Concept Element, most of the red lines would be bus routes using freeways with on-freeway stations allowing transfers between lines and with pedestrian bridges to major trip generators. Only one of the red lines would be light rail, that connecting Centre City with the international border. Here again we see the idea of light rail as being thought of as one set of links in a regional network. The idea was borrowed directly from Edmonton, although in San Diego's case the scale of the network was much larger. San Diego's first light rail line was 16 miles long in contrast to Edmonton's which was only about 5 miles long and was built for speed and longer distance riding (though analysis showed that there would be very heavy passenger turnover at several of the eleven stations between Centre City and the border, and that turned out to be the case)²⁴.

Mr. Nelson then demonstrated how the region could control the growth in unit bus costs by gradually replacing bus routes operated by San Diego Transit with lower cost operators. MTDB would coordinate all transit in the region similar to the Hamburg Verkehrsverbund concept. His argument was credible with Mayor Pete Wilson, who already was impressed by MTDB's ability to get an agreement from the Southern Pacific Company to buy the San Diego & Arizona Eastern Railroad for \$18.1 million. Wilson then added his considerable weight to the light rail cause, and the project went forward²⁵.

4. Results

An evaluation of the light rail movement needs to cover many dimensions which would exceed the space available for this paper. Here I wish to touch upon just a few aspects of patronage and costs for Edmonton and San Diego and several other systems that have opened more recently. Because the construction and operation of light rail can take resources

²³ San Diego Metropolitan Transit Development Board [1978a]; San Diego Transit Development Board [1978b].

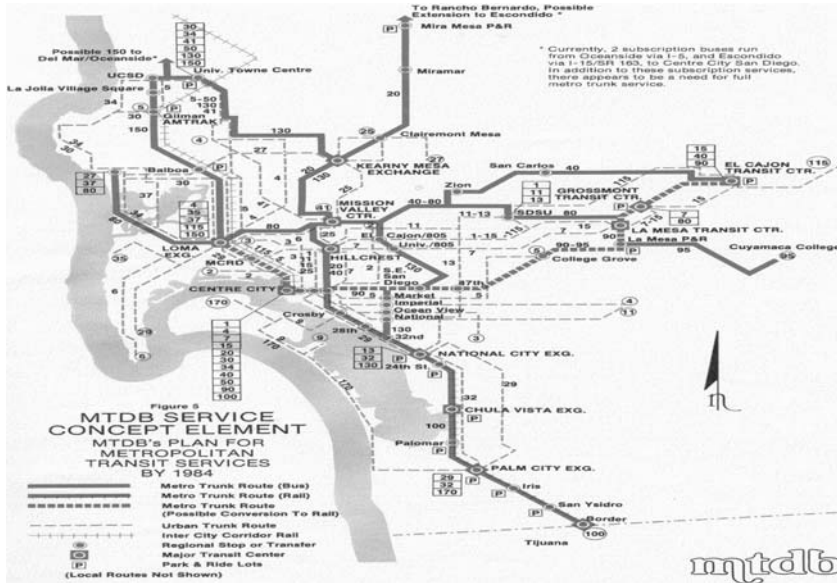
²⁴ San Diego Transit Development Board (1979).

²⁵ Interview by author with Mr. Benjamin Dillingham III, San Diego, 17 and 19 July 2002; Interview by author with Mr. Thomas Larwin, San Diego, 22 July 2002; Interview by author with Ms. Judith Bauer, Bonita, California, 18 July 2002. All three interviewees agreed that MTDB Board agreement with the Southern Pacific Company to sell the SD&AE to the MTDB for \$18.1 million was crucial in obtaining Mayor Wilson's support; newspaper articles at the time dwell on the importance of the Financial Plan, as well. Member Maureen O'Connor's obtaining an agreement with the Southern Pacific Company to sell the SD&AE to the MTDB for \$18.1 million was crucial in obtaining Mayor Wilson's support; newspaper articles at the time dwell on the importance of the Financial Plan, as well.

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away from the bus system in a metropolitan area, the examination considers total service and ridership of all transit modes in metropolitan areas over time.

Figure 4. Service Concept Element, 1979



4.1. Edmonton and Calgary

While Figure 3 called for the rapid development of a system of light rail lines for Edmonton, to date only one line has been achieved. It is the one shown in Figure 3 beginning in the northeast and extending to the CBD and then south across the river to the University of Alberta. Except for a bridge across the river, the entire segment from the northeast side of the CBD through the university is in tunnel with six underground stations. A new surface station is under construction south of the university.

Edmonton's light rail initiative has not reached its potential because of three factors. First, the line is really a heavy rapid transit line using light rail cars. When conditions turned favorable for transit capital investment in 1973, Mr. MacDonald pulled his heavy rapid transit plans off the shelf. These followed Toronto Transit Commission subway standards, including a minimum horizontal curvature of 600 feet radius. Mr. MacDonald did not want to deviate from these plans for fear of losing a window of opportunity in 1973. Consequently, the line was placed in subway in the central business district (CBD). This made extension to the south very expensive. The problem was compounded by a decision to tunnel under the

University of Alberta rather than use the Canadian Pacific Railway line to the south. This made infrastructure construction so expensive that light rail has not expanded beyond its initial line, although that line has grown in length.

Second, Edmonton's CBD, despite the huge investment in subway under it, entered into a substantial decline in the 1980s and 90s. The conservative Provincial government cut back government bureaucracy, emptying considerable downtown office space. (Edmonton is the capital of the Province of Alberta; Calgary in the business capital.) Oil companies also cut back office space in the downtown, consolidating their office functions in downtown Calgary, 180 miles to the south. Against the adopted plan for the expansion of Edmonton and the advice of its administration, the city council also approved the construction and expansion of a massive retail mall on the west of the city. Known as the West Edmonton Mall, the mall was reported by 2000 to be the largest mall in North American. Whether or not the claim is true, the mall is huge and caused much of downtown Edmonton retail activity to wither.

A third factor also is important. After three years of patronage growth, the system suffered a major strike about 1980. This was followed by large fare increases and service cutbacks. Having said that, I must note that the light rail line has the heaviest patronage density in the region, and it finally has reached the surface south of the University of Alberta. It now has the potential of fanning out. In addition, the bus system follows multi-destination principles, making use of the limited rail transit line as much as it can, which is why regional transit patronage has held up reasonably well given the huge losses in the CBD.

Calgary's light rail experience offers an interesting contrast to Edmonton's. Calgary's infrastructure takes advantage of the 85 foot turning radius of the U2 cars, and a surface alignment was built through its CBD. While the first line followed a railroad alignment to the south, the lines to the northwest and northeast were built in part in conjunction with new urban expressway construction (with urban standards rather than high speed intercity standards used for U.S. urban interstate highways), to which the light rail line could conform because of its ability to take tight curves. A more extensive system has resulted in Calgary reportedly with similar investment to that in Edmonton, effectively achieving the concept shown for Edmonton in Figure 3. In addition Calgary's CBD has remained vigorous, accounting for about 25 percent of regional employment, while Calgary's light rail system also directly services two universities and at least two of the region's major malls. A 50-day strike occurred in 2001, but in 2002 much of the traffic loss was recovered. Figure 5 compares regional transit patronage for the two systems.

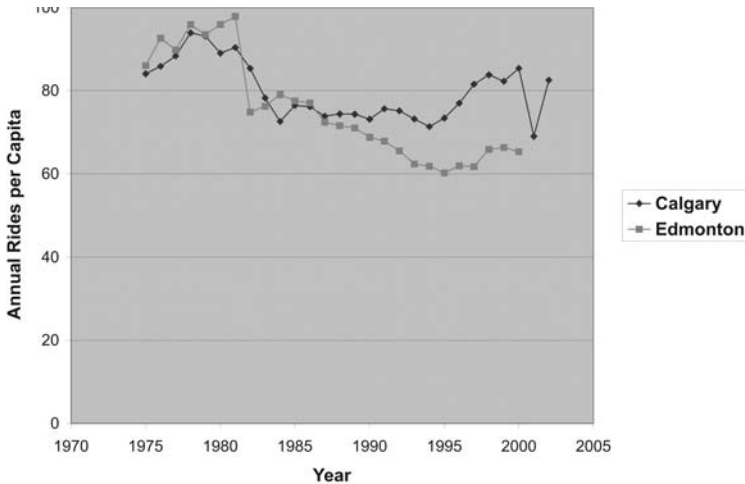
4.2. San Diego

Following the decision to construct light rail in 1978, MTDB's Mr. Robert Nelson and SDTC's Mr. Thomas Prior both resigned. MTDB's director of planning Mr. Thomas Larwin succeeded Mr. Nelson as MTDB general manager. Mr.

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Larwin spent much of his initial energy not only in building the first line, but in spreading oil over the stormy bureaucratic waters. Under Mr. Larwin's leadership, MTDB largely kept Mr. Nelson's promise. The magnitude of transit service roughly did double in the MTDB service territory over the ensuing 15 years with no significant increase in taxes supporting transit operations (there were additional taxes approved by the voters to build additional rail transit lines), while transit patronage also doubled, and light rail became politically popular.

Figure 5. Revenue trips per capita, Edmonton and Calgary.



Source: Edmonton data courtesy J. J. Bakker; Calgary data courtesy Calgary Transit System.

There were differences between transit service that expanded and the Service Concept Element, however. None of the red regional bus routes with their on-free-way stations were built. There was no political support for them. Instead, light rail expansion partially took their place. The red line running easterly from the CBD was built as a light rail line in the mid-1980s. The red line running first northwest and then east through the Mission Valley is partially open as a light rail line and will be completely open in 2005. Its extension running due north to UCSD also may be developed as a light rail line.

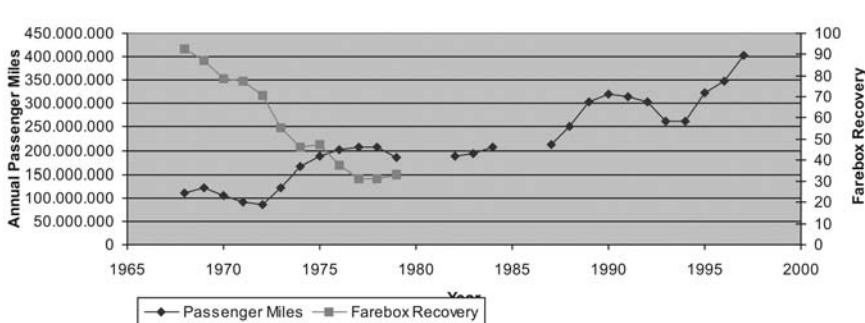
Figure 6 shows patronage trends. From 1972 to about 1975 bus patronage grew rapidly because of fare reductions and to a lesser extent service expansion, but the deficit also increased rapidly because of the compounded inflation of unit operating expenses combined with decreased fare revenue. After about 1980 unit cost increases stabilized, as shown in Figure 7, and service and patronage began to grow again. While not shown in the figure, fares have recovered more than 40% of operating expenses since the early 1980s. Patronage growth has exceeded population growth in the region.

3.3. U.S. Light Rail Performance

By 2003 fourteen cities in the U.S. and Canada that had no rail transit in 1970 opened one or more new light rail lines.²⁶ In most of these regions the great majority of population growth occurred after the automobile became the dominant mode of urban transportation in the mid-1920s. By 1970s transit use had become vestigial. In many cases transit work trip modal share was well under five percent.

How the transit systems were oriented with respect to travel demands differed between the 14 regions, and light rail's role within those systems also differed. Light rail developments in Portland and Sacramento followed the idea that Edmonton, Calgary, and San Diego used. This was the idea that light rail lines would serve the high demand links of transit networks that were restructured to serve multi-destinations. The author is not yet aware of whether other light rail implementations have followed this approach.

Figure 6. Patronage trends in southern part of San Diego County



Source: Calculated by author from SDTC annual reports, MTDB annual reports, and National Transit Data Base

Many of the new systems have been criticized for costing more while carrying fewer riders than promised during the planning phases. It is said that resources could have been better used improving bus services. (Richmond 2002). Polzin (2003) provides a comprehensive review of the operations and performance of all

²⁶Edmonton, Calgary, San Diego, Portland, Sacramento, San Jose, Buffalo, Los Angeles, Denver, St. Louis, Baltimore, Dallas, Salt Lake City, Houston. New light rail lines are under construction in Minneapolis-St. Paul and Phoenix. Pittsburgh, Boston, Philadelphia, and Cleveland rebuilt suburban streetcar lines using light rail technology. Toronto built two new light rail lines that are much more urban in character than light rail lines in other regions, and it has reequipped its traditional streetcar system, the largest traditional streetcar system left in North America, with light rail vehicles. Philadelphia, San Francisco and Boston also rebuilt their remaining urban streetcar systems, all of which have subways in the CBDs, using light rail technology, and San Francisco added a new light rail line and another traditional streetcar line to its system.

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U.S. light rail applications, including the renewal of old streetcar lines. His analysis puts light rail in a more favorable light.

My colleague Tom Matoff and I also have looked at this matter in some depth and concluded that light rail investments have done very well in at least some areas. Our analysis shows that how light rail is situated in its regional transit network affects transit performance. The three urban regions that we examined with multi-destination transit systems that include light rail (San Diego, Portland, Sacramento) generally experienced growing usage per capita following restructuring of networks while those that viewed their transit systems as serving primarily their CBDs experienced decline over time. Moreover, Thompson and Matoff found that the operating and capital costs per passenger mile for multi-destination systems containing light rail were approximately the same as for cities that invested primarily in bus rapid transit. They were much less than for regions that maintained traditional CBD-centered collections of radial bus and rail routes²⁷.

For this paper I have prepared Table 1 that examines usage trends between 1990 and 2000 more systematically. It first shows the median transit performance in all metropolitan statistical areas in the U.S. that had a 2000 population of 500,000 or greater (76 observations). It then summarizes performance of all transit services in Metropolitan Statistical Areas where light rail was introduced after 1970. In most cases these regions had no rail transit service before 1970. The San Francisco region is the exception. In 1970 it had five streetcar lines, three cable car lines, and it was just beginning to open its BART regional rapid transit service. It was in an outlying part of the region centered on San Jose where new light rail service started in 1986. Finally, Table 1 presents performance in several other regions. Houston, Seattle, and the Twin Cities have invested heavily in bus rapid transit. Columbus, the capital of Ohio, has been compared to Sacramento, but unlike Sacramento it has made no guideway capital investment in its transit service. Twenty years ago it had higher per capita transit usage than Sacramento. Kansas City is in the same state as St. Louis and like St. Louis experienced rapid loss of transit patronage through the 1980s.

In several of the regions shown with light rail, the light rail lines have become the most heavily traveled transit links in the region, but this is not true in the case of the Bay Area, where the San Jose light rail line is only a tiny part of total transit services in the region. That line is reported in the press as not very successful, but we do not have separate figures for it. The Baltimore light rail line also is only a small part of transit services in the Washington, D.C. region, and we have no separate figures for it.

Table 1 shows that the median U.S. urban region increased transit service faster than population grew. Service (vehicle miles) per capita grew by 6 percent between 1990 and 2000. Despite that, unlinked trips per capita declined by 12 percent and passenger miles per capita declined by 10 percent. The average number of passengers on board a vehicle at any one time also declined by 10 percent.

²⁷ Thompson and Matoff (2003), pp. 296-312.

In general, regions that introduced light rail did much better than the median. Most of them were able to expand transit service, both bus and rail, by more than six percent. Usage per capita increased even faster, so that productivity increased. Portland, for example, increased service per capita by 11 percent between 1990 and 2000, and demand increased three times faster. Unlinked trips per capita (the number of passengers boarding vehicles in a given year) increased by 26 percent, while passenger miles per capita increased by 43 percent, according to the data.

The bus rapid transit cities also do relatively well. Seattle's comparatively high usage in part results from its comparatively high expenditures on transit. In 1998 the region spent about \$154 per capita to support transit operations compared to \$50 for Sacramento, \$57 for San Diego and \$95 for Portland. It also spent two to three times as much per capita for capital investment as the three light rail cities²⁸.

Table 1. Transit performance between 1990 and 2000 in new start light rail MSAs

	% change from 1990 to 2000				Passenger miles per capita in 2000	Date first light rail service opened
	Vehicle miles per capita	Unlinked trips per capita	Passenger miles per capita	Passenger miles per vehicle mile		
Median of 76 MSAs	0.06	(0.12)	(0.10)	(0.10)	54	
Portland	0.11	0.26	0.43	0.28	169	1986
St. Louis	0.16	0.15	0.30	0.12	100	1995
Denver	0.31	0.11	0.28	(0.02)	142	1994
Sacramento	0.15	0.30	0.25	0.08	83	1987
San Diego	0.22	0.25	0.24	0.02	186	1981
LA	0.25	0.04	0.11	(0.11)	165	1989
Dallas	0.01	0.01	0.02	0.01	67	1997
Buffalo	(0.07)	(0.06)	(0.07)	0.01	71	1987
Salt Lake City	0.02	(0.19)	(0.34)	(0.35)	92	2000
San Francisco	0.07	(0.05)	0.03	(0.04)	378	1986 (San Jose)
Washington, D.C.	0.06	(0.11)	0.02	(0.04)	318	1993 (Baltimore)
Seattle	0.13	0.12	0.18	0.04	239	
Twin Cities	0.14	(0.05)	0.11	(0.02)	116	
Houston	0.11	(0.12)	(0.02)	(0.12)	121	
Columbus	0.07	(0.11)	(0.24)	(0.29)	48	
Kansas City	(0.04)	(0.28)	(0.14)	(0.10)	33	
New York	0.01	0.05	0.11	0.10	863	

Source: Calculated by author's research assistants from National Transit Data Base.

Figure 7 shows operating expense trends per passenger miles in several of the urban regions and addresses the criticism that light rail investments increase transit operating costs compared to regions that have all-bus transit. Figure 7 does not support the criticism. The region with the lowest operating cost is San Diego.

²⁸ These numbers are from the background calculations for Thompson and Matoff [2003] and are available upon request.

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Sacramento and Portland, where light rail carries the heaviest passenger volumes in their respective regions, carry their passengers at about the same expense per passenger mile as the all-bus regions of Seattle, Houston, and the Twin Cities. Columbus, which has little or no investment in transit fixed facilities, has very high operating expenses.

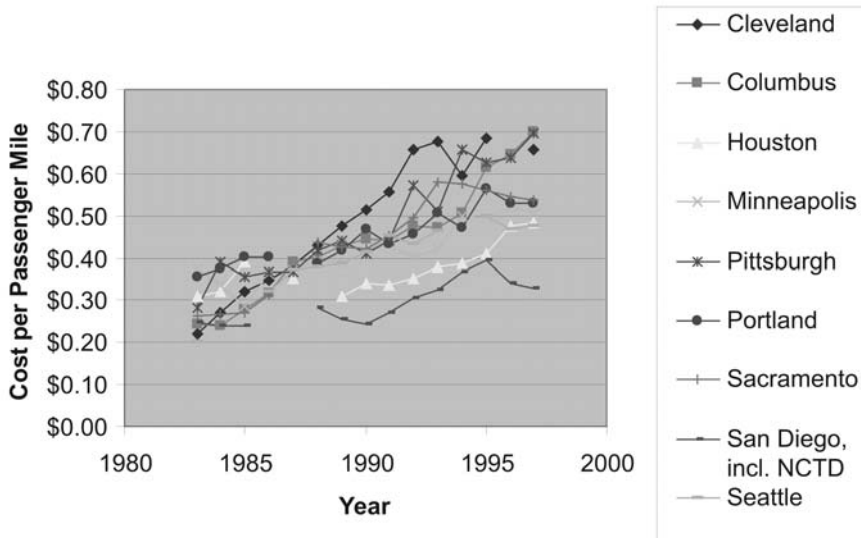
5. Conclusion

Why did light rail transit happen in North America, and what have been the results? The study addressing these questions is on-going, but research to date suggests tentative answers. As to the first question, the answer appears to hinge on distrust that some citizens and politicians developed toward traditional transportation institutions and organizations in the 1960s and 1970s. Adverse consequences from the construction of huge urban interstate express highways was arousing antipathy to the roads movement, while the decline of transit that largely was privately owned and operated suggested the need for new institutions and organizations to provide an alternative to roads. In response new laws and funding created new publicly-owned transit organizations in the U.S., but in most cases the new transit agencies did not look beyond local buses or heavy rapid transit. New forms of intermediate capacity transit that had many of the performance attributes of rapid transit at a cost that seemed affordable for many U.S. cities were being developed in some northern European cities. It appeared to reformers generally outside of the transit industry that such systems might change travel habits in U.S. cities. Their efforts led to the light rail movement in the U.S. and to a lesser extent Canada.

The light rail movement continues, and results are continuing to unfold. To date they suggest incremental improvement to transit usage and performance; not revolutionary displacement of the automobile. Transit use per capita has increased markedly in several of the regions that opened their first light rail line a decade or more ago, particularly for those

that construed light rail as high capacity links in multi-destination bus systems. Operating costs per passenger mile and capital costs per capita are not much different than for urban regions that have invested in express bus infrastructure. In general it appears that the light rail movement has been good for the users of transit and for the transit industry. However, the light rail movement has made hardly any penetration of the automobile market. Transit work trip modal share has gone up marginally in several of the regions that implemented light rail and one that has not, while it continues to decline substantially in most urban regions in the U.S.. In all urban regions in the U.S., decentralization continues, automobile congestion worsens, and air quality worsens, as well. It is unlikely that the light rail movement will change any of this. What it may be doing in some areas is creating urban and suburban environments in which the minority whose ability to use an auto is constrained, or those who choose not to partake of the automobile culture, can live and travel in a civilized manner.

Figure 7. Trends in operating expense per passenger mile for all transit in selected MSAs



Source: Thompson and Matoff (2000).

6. Acknowledgments

In addition to interviews cited in the text, I since have formally interviewed Mr. Thomas G. Matoff, Mr. D. J. Smith, Mr. John Schumann, Mr. Larrie Taylor, Mr. Sammuel Zimmerman, Dr. Brian E. Sullivan, Mr. Steven Parry, Mr. Walter Quintin, and Mr. Robert Clark. I also have obtained invaluable assistance from Mr. James Graebner, and Mr. Anthony Palmere, who are slated for formal interviews. These persons will figure more prominently as I proceed with the story. I am indebted to these persons and others with whom I have gained insights in the past but have not talked with recently. I also express special thanks to Mr. Jeffrey Mora, recently retired from the Federal Transit Administration (successor to UMTA) for bringing to my attention many of the important actors, whom I later interviewed. Any mistakes or omissions remain my responsibility.

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Interviews:

10 June 2002

Mr. Jeffrey Mora. Federal Transit Administration in his office

10 June 2002

Mr. Robert Abrams. Urban Mass Transit Administration, retired; in his home in Washington, D.C.

11 June 2002

Mr. Campbell Graeb. Transportation Research Board (retired); in his home in Chevy Chase.

11 June 2002

Mr. William Adams. Urban Mass Transit Administration (retired) in office above Georgetown restaurant

13 June 2002

Dr. Vukan Vuchic. Professor, Engineering and Planning, University of Pennsylvania, Philadelphia, in his office

14 June 2002

Mr. Stewart Taylor. Consultant, and Urban Mass Transit Administration, retired, in Army and Navy Club, Washington, D.C.

14 June 2002

Mr. Kenneth Orski. Deputy Administrator, Urban Mass Transit Administration (retired), in Army and Navy Club, Washington, D.C.

16 July 2002

Mr. Kenneth Sulzer. Deputy Director and Director (retired), San Diego Comprehensive Planning Organization (renamed San Diego Association of Governments about 1980). In his home in San Diego.

17 and 19 July 2002

Mr. Benjamin Dillingham, III. Director of Finance (retired), San Diego Metropolitan Transit Development Board, and Chief of Staff for Maureen O'Connor, member and chair of MTDB Board and Mayor of San Diego. In his home in San Diego.

17 July 2002

Senator James R. Mills. President pro tempore of California State Senate (retired), and Chair of MTDB Board, retired. In his home in Coronado.

18 July 2002

Ms. Judith Bauer. Chair of MTDB Board (retired). In her home in Bonita, CA, 18 July 2002.

22 July 2002

Mr. Jaswant Kooner. Principal engineer, County of San Diego (retired), and engineer, Edmonton Transit System (retired). In his home in Del Mar.

22 July 2002

Mr. Thomas Larwin. General Manager since 1979 of San Diego Metropolitan Transit Development Board. In his office in San Diego.

6 August 2002

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Mr. Arthur Bauer. Consultant to California Senate Transportation Committee (retired), consultant California State Senate Office of Research, and as such, assistant to Senator James R. Mills. Currently consultant. In his office in Sacramento. (No relation to Ms. Judith Bauer.)

7 August 2002

Mr. Thomas G. Matoff. Planning and implementing Portland Eastside bus restructuring, placing Portland and San Jose light rail lines into operation, general manager, retired, Sacramento Regional Transit, and currently consultant with LTK. In his home in Winters, CA.

13 August 2002

Mr. William Kuyt. Commissioner of Transportation (retired), City of Calgary. Phone interview to his home in Calgary.

14 August 2002

Professor John J. Bakker. Professor of civil engineering (retired), University of Alberta, consultant to Edmonton Transit System, confidant to ETS General Manager and Edmonton Director of Transportation, Don MacDonald. Phone interview to his home in Eagle Lake, BC.

15 August 2002

Mr. Rudy Massman. Director of public works (retired), San Diego County, director (retired), of county department of transportation. Phone interview to his home in Poway, CA.

16 August 2002

Professor Peter Boothroyd. Director (retired), Edmonton Social Planning Council, Professor of Planning, University of British Columbia. Phone interview to his home in Vancouver, BC.

20 August 2002

Mr. John Schnablegger. General manager (retired) of Edmonton Transit System, director of transportation (retired), City of Edmonton. Phone interview to his home in Vancouver, British Columbia).