The potential application of monorail technology as a tool for economic redevelopment—a case study Fresno, California

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Abstract

Often transportation authorities regard monorail technology as appropriate only for theme parks and airport people movers. This is despite the fact the Wuppertal, Germany monorail, the world’s oldest operating monorail system, has carried in an urban transportation environment more than two billion passengers since 1901. Recently, monorails have been planned and built as an integral part of intermodal urban transport systems.

Proponents of monorails argue that monorails have both low construction and operating costs, have very low accident rates because of being elevated away from surface traffic, are environmentally friendly and aesthetically pleasing.

Fresno, California has experienced a deterioration of its urban central core. The post World War II discovery of its suburbs made largely possible by the highway and automobile revolutions have shifted resources away from, and thus impoverishing, Fresno’s center. The city seeks to reverse this trend.

Fresno’s strategy to correct this situation is to develop a comprehensive, essentially privately funded, automated monorail system. Associated with the monorail operation would be a system of small neighborhood shuttle buses.

This paper examines the validity of Fresno’s proposed monorail from both technological and strategic perspectives.
1 Monorails’ Advantages

A monorail operates on a single rail that performs the function of a track for passenger or freight vehicles. As such, a monorail can run at grade, below grade in a subway, but most likely in an elevated configuration. It is as an elevated system monorails optimize their operational and economic characteristics. Vehicles straddle the rail or guideway or are suspended from it.

Proponents of urban monorail systems, as an integral part of urban transit, base their arguments on a variety of considerations that they claim prove their desirability. Central to the argument is that monorails are a proven mode of urban transit. The world’s monorails successfully carry each and everyday hundreds of thousands of passengers. Most of the “transit” monorails are in Japan, seven of which are full-scale urban transit systems. The monorail at Florida’s Walt Disney World has more than 100,000 daily boardings, higher than many American light rail systems.

Monorails are safer other rail modes. Their design does not allow for derailments. The problem of surface traffic accidents – whether with other vehicles or persons – is eliminated with the elevated monorail. Operational costs are accordingly reduced. As electrically powered vehicles they are non-polluting as they operate. Most systems use rubber tires and are quiet. The simple elevated relatively inexpensive design produce comparatively fast construction time, resulting in less disruption to the surrounding environment including medians, streets, buses, traffic patterns and business and residential communities. Again monorails lessen costs.

Studies associated with a proposed monorail for Los Angeles’ dense Wilshire Corridor have concluded that a Wilshire monorail could be built for as little as ten to 15 percent of the capital cost to build the Los Angeles subway. A Wilshire bus-way system, another inexpensive alternative, would require the loss of several parking lanes and/or all of the medians. The only street area required for the monorail would be medians to locate support columns.

Importantly, monorail advocates contend that monorails will achieve significantly higher levels of ridership than an all-bus system. Fewer residents will drive if given the monorail as a feasible alternative. Thus, a region’s air quality will be improved.

In order for transit to be successful in achieving community goals it must have strong public appeal. This appeal is based on offering a reliable, (monorails regularly operate at 99.9% reliability) intelligent and innovative alternative to the private automobile and the bus. Monorail supporters claim that the monorail meets these standards and thus provides an important strategy to obtain increased transit utilization. The role of the bus within a monorail-based transit system is to feed riders in a seamless manner to and from monorail stations.
2 Technological Feasibility

Monorail development as a viable urban transit mode was for many years hindered by the belief that monorail systems had an inability for rapid reliable switching. The basis of this belief is rooted with the technology of the historic Wuppertal monorail. This system uses double-flanged steel wheels to run on a single elevated rail. The vehicles are suspended below. Due to the "hang-over-the-side" design of the suspended vehicles, switching requires cumbersome rotating switches. Thus, effectively branch lines and bypasses are eliminated. Since such operations are often essential for an urban transit system, the "switching problem" was a major drawback with respect to monorail application.

Today, the "switching problem" has been solved. For example, the Osaka monorail, a straddle-beam monorail featuring segmented track, successfully switches trains reliably at high speeds using a segmented switch developed by the Alweg Company in the 1950's. The segmented track allows the beam to go from a straight position to a curved one. This way little space is used for the switch.

Other examples include Tokyo-Haneda monorail. Alweg straddle-beam technology is used for this eight-mile dual-beam system. Segmented and new high-speed crossover switches operate every few seconds. This system has proven monorail switches reliable for more than thirty years of daily operation. Other examples could be cited, but the important fact is that high speed switching is not an issue that precludes monorail operation as an urban transport mode.

3 Fresno Metropolitan Area

Fresno, located in the hub of the San Joaquin Valley in central California, was the fastest-growing big city in the United States during the 1980s, with a growth rate of 61.3 percent. Its 1990 census population was 354,202, up from 218,202 in 1980. The population estimate for 1994 was 386,551. The Fresno metropolitan area grew from 578,000 in 1980 to 755,580 in 1990, reaching an estimated 844,000 in 1995. Much of the growth was fueled by the arrival of families from the more crowded Los Angeles and San Francisco metropolitan areas, who were attracted by Fresno’s affordable housing and low cost of living. The relocation of businesses from other urban areas offered new employment opportunities.

The city of Fresno occupies a land area of 99.1 square miles. Despite the fact the downtown was revitalized in the 1960s with the completion of a major shopping mall and a convention center, which underwent expansion in the mid-1990s, the psychology of urban sprawl has firmly established itself in the real estate market. The result has been a decline in Fresno’s population density during the past twenty years.

The population and economic growth have ironically accentuated the continued deterioration of, and flight from, an even increasing central core.
focus has been on new construction to satisfy the growth. This has been largely outside the traditional boundaries of Fresno with the result that the central core has incurred relative neglect, producing economic deterioration. Since Fresno lacks a developed and accepted public transit system (other than an under-utilized all bus system). The private automobile life style has been a major factor in Fresno’s geographic spread and decentralization. As the geographic range of Fresno increased distances between travel points on average increased. Dependence on the automobile, likewise, increased. The single car family of half a century ago may now require three or more cars.

Fresno is a large city; soon it will be probably become a major metropolis. Currently, Fresno faces two fundamental choices with respect to growth. Either Fresno will continue to sprawl outwards around an ever bigger decaying urban core while it “chokees” on traffic; or Fresno will be further developed and restored within its existing boundaries, with vibrant business, residential, shopping and entertainment districts.

Advocates of the restoration of Fresno argue what will alter Fresno’s growth pattern is a fast, efficient, and affordable public transportation system that people will choose over private automobiles.

4 Fresno’s Public Transit Modal Choices

If Fresno decides to allocate an increasing amount of resources into public transit as a revitalization tool there are several modal choices for the focus of such an expansion:

- Dedicated Bus Lanes
- Light Rail
- Subways
- Elevated Guideways

Bus and light rail systems operate at street level; to have any operational advantage in relation to the automobile they must have substantially dedicated routes. Separation of street-level rapid transit from ordinary traffic requires thorough advance planning; Fresno has developed past the point at which it is possible unless at a substantial economic cost, both in terms of absolute expenditure and significant physical disruption during construction. Such disruption could have potentially negative results both in the short and long run upon the economic base the expanded transit system is designed to aid.

Subways are so expensive they can only be cost effective for the biggest, most highly developed city business districts -- such as New York, San Francisco, Tokyo, London, and Paris. Fresno lacks and will lack the population base both in terms of size and density to generate ridership levels that would make a subway-based system efficient from a cost-benefit perspective.

Given the above considerations, the feasibility of evaluating elevated guideway systems, such as monorails, as a practical transit solution for Fresno is warranted. Elevated guideways, as previously noted, do not interfere with surface
traffic, nor are they slowed by it; they are far less expensive than subways and may even cost less than buses in the long run; and they can be readily installed along existing streets. The potential cost savings over time of a monorail system compared with an all bus operation are due to the facts that trains require less labor (they may in fact be automated) than buses to move large amounts of riders and the longer life cycle of electrically based equipment.

The selection of the core mode to meet Fresno’s future public transportation needs not only to be based on the above considerations, but also the mode’s ability to benefit the community in the following ways:

- Promote development of infill areas (under and undeveloped urban areas).
- Prevent or reduce the rate of urban sprawl.
- Utilize existing infrastructures.
- Increase property values.
- Enhance a sense of community.
- Render full development of high-rise areas.

5 Fresno’s Proposed Monorail Plan

They have developed a proposed monorail system for farther evaluation as to its feasibility by a citizen’s committee called “Fresno Area Sky Train.” The group envisions a metropolitan transportation system centered on a high-speed monorail system served by a fleet of small, environmentally friendly neighborhood shuttle buses running so frequently no one will need a schedule.

The monorail system’s routing will concentrate growth along existing designated high-rise corridors. In such corridors, given the quality of the transportation investment the monorail system presents, monorail advocates contend, the monorail will provide both direct and indirect positive financial incentives for the private sector to halt urban sprawl. It will promote infill development, efficient use of existing infrastructure, redevelopment of older parts of the city, and maintain or improve air quality. It will encourage the development of local transit-centered mixed use neighborhoods that will become human-scale communities of their own. It will increase property values throughout the metropolitan area.

The most unusual aspects about the Fresno monorail proposal are the linkage to urban revitalization and the scope and intensity of the proposed system. The planned six line system will provide monorail service on most of Fresno’s major surface street corridors. All major traffic generators will be directly served including all major hospitals, shopping districts, public transportation systems (airport, bus, railway station), most governmental office buildings, major hotels, the convention center, college and university campuses, and park and recreational facilities.

Stations are planned to be spaced every half mile on each line. The stations are to be built over intersections and are to be designed to accommodate
retail and office space and therefore providing both additional traffic generators and revenues for the system.

Access to the monorail system, would also be provided by a fleet of small (twenty-five to 30-foot) fixed route shuttle buses whose primary function would to transport passengers to and from the nearest monorail station. Presumably their prime purpose would be to transport passengers who had origins and destinations beyond one-quarter mile of a monorail station. It is assumed that persons within the one-quarter mile zone would find it more convenient to reach a monorail station by walking.

Each branch of the monorail system will have its own color-code. Buses and bus stops within a service zone to serve a given monorail branch will likewise have the same color-code. Thus, yellow-coded buses and bus stops will service the yellow-coded branch. Wherever practicable no location within a given service zone will be more than two blocks away from either a monorail station or shuttle stop. Headways will range from ten minute rush hour service to twenty minute off-peak and weekends.  

6 Claimed Community Benefits

Proponents of the proposed Fresno area monorail system argue that once the system is in place residents within the service area will have the economic inventive to reduce the number of automobiles per household. Three-car households, for example, will now have the option of becoming two-car households. The system will create the environment for a trend to develop for fewer per household, thus reducing congestion, demand for parking spaces and releasing household income for non-automobile purposes.

As these benefits become apparent, the demand for residential property within the service area will increase thereby accelerating property values. Advocates farther contend that this increase in property values will provide the economic incentives for residents to upgrade and maintain their property. Increased property values will encourage financial institutions to increase the availability of loans for residential improvements.

The system, proponents claim, will both create incentives and opportunities for increased population density and vertical development. New retail and office developments would require less parking spaces (assuming the Planning Department concurs) given that now a significant segment of their customers and/or employees would reach the facility by the monorail system. Capital costs associated with such projects would be thus reduced. Space, in short, would be cheaper to produce making the Fresno business market a more attractive and competitive location. Fresno has one of the lowest costs to development ratios in California. 

The combined effects of the monorail system on Fresno’s residential and business sectors will enhance the development of the urban core including its designated high-rise business districts. Within the Fresno urban core there is an estimated 18,000 available infill lots. It is estimated that this equal to 10,000 acres.
A prime target of the Fresno urban revitalization program, of which the monorail system is the catalyst, is the economic use of these properties.

As Fresno achieves greater densities within the urban core area, the tax base will strengthen because improvements, notably high-rise complexes, will generate increased tax revenues compared with vacant land and single story development.

Since the relationship between the monorail system and the revitalization of Fresno's urban core is to be through infill development, the existing underutilized infrastructure (roads, water and sewer lines, and underground utilities) would largely be employed to handle the new economic activity. This will result in a cost saving compared to having to provide new infrastructures.

Since the monorail system will emphasize core development the rate of urban sprawl will be lessened. Urban sprawl makes governmental services more expensive and less efficient by spreading them over a larger area.

In short, advocates of the monorail contend that it will create natural economic incentives to initiate new growth in the Fresno core area, slow urban sprawl, strengthen the tax base, decrease congestion, improve air quality, make commerce more competitive and very importantly create a sense of community.

7 Work-Plan Methodology

At this time the Fresno monorail plan (as set forth above) has only been conceptually developed. Phase two (currently under way) involves establishing the feasibility of the proposed fixed guide-way (monorail) system from both a technical and economic standpoints.

What is the demand for this type of service in Fresno? An assumption was made that patronage will be directly related to Fresno's demographic characteristics. Benchmarking Fresno's current demographic characteristics are relatively straightforward. This would include city wide population, population density along corridors, profile by age and automobile registration levels. Growth patterns are to be developed.

Since Fresno lacks a significant transit infrastructure, the use of proxies will develop the relationship between population traits and ridership. To derive the projected forecast ridership, population to ridership ratios will be determined for an array of North American rail services. The basic weight used to generate ridership values would be the mean value of these ratios. A modifying factor would be the future growth of land-use as outlined in the general plan and other relevant planning documents. From ridership values revenue projections will be developed.

General operational evaluation of the three main alternatives to the monorail system will be made—current bus lines (Fresno Area Express), doubling of the current bus system and light rail at grade. Ridership, revenues, capital and operating costs will be established both on the basis of aggregate requirements and values per vehicle mile. The purpose of this evaluation is to benchmark the monorail system against alternatives to help establish the relative viability or lack
thereof of the proposed monorail system.

The proposed monorail system will receive a detailed cost-benefit evaluation. Direct capital costs will include the elevated rail infrastructure for the six-branch system, sufficient cars to meet ridership demand and scheduled maintenance requirements while achieving at least five-minute headways during rush-hour, appropriate number of feeder buses, Central Control and maintenance facilities, access stations and right-of-way acquisition including the need, if any, for eminent domain.

Depending on the adopted final design, they estimate that the preliminary cost estimates were between twenty-five and forty million dollars per mile for monorail construction over existing boulevards and thirty-five to fifty million dollars per mile for downtown construction. The estimated capital costs, including vehicle and maintenance facility costs, ranges between one billion dollars and one and a half billion dollars.

The estimated one to one and a half billion dollar capital costs for the system would need to come from following sources:

1. Fresno County must first pass a bond measure for 25-35% of the total capital costs or approximately 300/400 million dollars. A logical source for the repayment of this money (including interest) would be a twenty-year extension of the currently in place Measure C sales tax initiative. Since typically such bond issues, to be successful, require two-thirds voter approval a significant voter campaign selling the desirability and economic value to Fresno of the monorail system.

2. Private/bank financing for match of the 25-35% of the total cost. This assumes that the bond issue is successfully approved by the voters. This funding would be used primarily to construct the stations which would include private sector commercial and residential space.

3. State and Federal funding programs would be used to provide the remaining balance.

The prime operating costs would be labor, power and maintenance associated with operations. This costs compared to the forecasted revenues will determine the amount of the subsidy required.

The cost-benefit analysis will identify and evaluate the major environmental impacts—both positive and negative—associated with the deployment of the elevated monorail system. These would include the impact on air quality (pollution), urban sprawl/farmland preservation, urban noise and visual aesthetics. Other considerations would be the reduced community aggregate out-of-pocket direct transportation expenses (due to the reduction of automobile operation), economic value of reduced travel time and increased revenues both private sector
and governmental as a result of the derivative incremental activity the monorail creates.

Revenues to fund the project potentially will come from a variety of sources. These include user fees (fares), revenues from property development, advertising, incremental tax revenues.

8 Concluding Comments

The Fresno monorail plan deserves consideration because of two key elements. First, the large-scale application of monorail technology which is unique for North America. Second, the purposeful use of transit as a major tool for redevelopment, curbing urban sprawl and improvement in the quality of life.

Whether or not the system will become a reality will depend upon on the findings of current feasibility study and the public support of the bond issue. If the system is built then its success in achieving both its non-transit and transit related goals will determine whether or not the monorail will become an integral component of North American urban transit.

Note – Walter Rice is one of the California Polytechnic State University, San Luis Obispo, consulting team member for the Fresno monorail project.

References

[9] Ibid. p. 7.