Chapter 6

Life Cycle Cost Model

The definition of life cycle costs is all of the cost incurred from the conceptual design phase, production and deployment of the system, through to the retirement and disposal of the system. The consideration of the "cradle to grave" costs in the design process is crucial to the determination of long term profitability of the MAGLEV transportation system. The life cycle cost can be viewed as the equivalent value of the system cash flow over the lifespan at some zero time. For the comparison of alternatives with similar lives, one can use either a present worth method or a capitalized cost method. The present worth method is the calculation of a net present worth of the system and is used for the comparison of alternatives with finite lives. The work presented here uses this type of calculation. For systems with infinite horizons, capitalized cost methods are used in which the life cycle cost is the amount of money needed at a zero time to perpetually support the system using only the earned interest. The MAGLEV vehicles are analyzed here for a finite life, although a capitalized cost approach may be warranted if system life extensions are expected.

As was mentioned, this model is a present worth method in which the life cycle cost is presented as a net present value of the system cash flow over the lifespan of the system via a discounted cash flow analysis. This model does not include fixed costs, since we are looking here at making design decisions for vehicle shape based on its effect on the overall system performance. These fixed costs include the development cost, disposal costs, fixed direct operating costs, indirect operating costs, etc. Such costs, along with stations and guideway costs, must be included when analyzing the transportation system as a whole for comparison with other modes of transportation.

The variable costs associated with changes in the vehicle shape design are the investment cost (acquisition) and the discounted operating cost. The investment cost is provided by the acquisition cost model, and the yearly operating cost is provided by the direct operating cost model. Several assumptions are made concerning the system economics. The lifespan is set at 15 years. Over this time, the average inflation rate is 3% per annum, the interest rate (return on investment) is 6% per annum, the tax rate is 50%, and the growth in traffic is 4% per annum. These values were taken from Ref. [17] which is part of the Grumman system concept definition. This model also has a revenue stream which is not employed for the studies performed as part of this work. Estimates for the fixed costs can be obtained from the work breakdown structure for the Grumman system. This can be seen in Ref. [3] prepared by Parsons Brinkerhoff. Their estimate for total capital cost amounts to $12302 per meter of track (the work breakdown structure was prepared for a 1000 km track system). Of this total, $7934 per meter is associated with the guideway, $1836 with the electrical, communications, and control for the system, and $882 with buildings and equipment (including stations). Their estimate for the vehicle cost is $1650 per meter, although these costs are variable with respect to the design variables of this multidisciplinary design.

The use of life cycle cost as a figure of merit is necessary to compare the designs based on performance and cost components. Life cycle cost is a universal figure of merit including all of the lower level objectives and indicators. It balances the initial capital investment with the annual costs associated with operating the system.