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Transportation Forecasting: A Review

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Abstract

Transportation forecasting is an attempt of estimating the number of vehicles or people that will use a specific transportation facility in the future. Traffic forecasts help to explain what the needs of the future might be and provide benchmarks for proper design and efficient transportation system operation. This paper aims to analyze in an original approach how a good transport forecast can lead to a better management in transport, with significant effects on transport system.

Keywords: *Transportation forecasting, Traffic Forecast, Passengers, Freight, Economy*

INTRODUCTION

The mobility of passengers and freight has always been fundamental components of the economic and social life of societies. Contemporary economic processes have been accompanied by a significant increase in mobility and higher levels of accessibility. A historical perspective on the evolution of transport systems underlines the impacts of technological innovations and how improvements in transportation were interdependent with economic, social and spatial changes. The current transport systems are thus the outcome of a long historical evolution marked by periods of rapid changes where new transport technologies were adopted.

The assessing of transport demand variability leads to proper forecast and development of the transport system, knowing that the market price is determined on equilibrium between supply and demand.

Transportation forecasting is an essential element of efficient development of road networks of cities, districts and regions at the national level. Development and implementation of a computer model of a transportation system of traffic gravity areas is the basis of traffic forecasting.

Transportation forecasting is the attempt of estimating the number of vehicles or people that will use a specific transportation facility in the future. For instance, a forecast may estimate the number of vehicles on a planned road or bridge, the ridership on a railway line, the number of passengers visiting an airport, or the number of ships calling on a seaport.

Traffic forecasting begins with the collection of data on current traffic. This traffic data is combined with other known data, such as population, employment, trip rates, travel costs, etc., to develop a traffic demand model for the current situation.

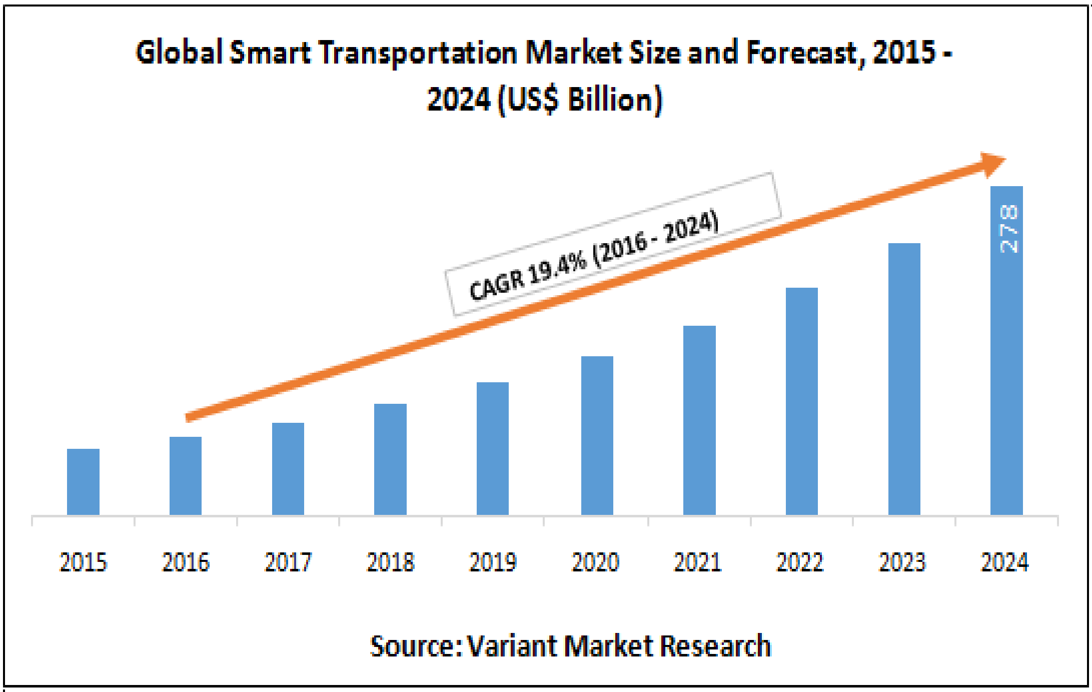

Figure: 1

Feeding it with predicted data for population, employment, etc. results in estimates of future traffic, typically estimated for each segment of the transportation infrastructure in question, e.g., for each roadway segment or railway station. The current technologies facilitate the access to dynamic data, big data, etc., providing the opportunity to develop new algorithms to improve greatly the predictability and accuracy of the current estimations.

Traffic forecasts are used for several key purposes in transportation policy, planning, and engineering: to calculate the capacity of infrastructure, e.g., how many lanes a bridge should have; to estimate the financial and social viability of projects, e.g., using cost–benefit analysis and social impact assessment; and to calculate environmental impacts, e.g., air pollution and noise.

ASPECTS OF TRANSPORT FORECAST

The forecast is defined as estimating the evolution of processes and future phenomena, the positive and negative effects they can generate on the managed system as well as the different strategies and scenarios of action for minimizing risks and maximizing the degree of achievement of the pursued objectives [6]. The forecast is made through diagnostic, forecasting and planning techniques.

The forecast models can be framed, as well as management types, over how long the concepts are achievable with great probability, in: strategic, tactical, and operative. Planning, as a management function (in English managerial literature, the foresight function is presented under the name of Planning), has been distorted in the centralized command economy, in which the essential relationships between the sectors of the economy and the functioning of the market was neglected, byneglecting the supply and demand law and by quasi-total elimination of the economic competition [7].

In the field of transport, abandoning planning was equivalent to limiting the state intervention in the field, which led to a fierce competition of the transport modes in both road and rail transport. The lack of regulation, and especially the lack of coherence in the applied pricing, has led from the complementarity of transport modes to competition, even where the areas of interest and competence clearly belong to one mode of transport.

The forecast, as a function of management, consists in the continuous attempt of building a more realistic picture of the future that corresponds to the achievement of the proposed objectives of the management. The degree to which the prefigured future becomes reality is the true confirmation of the quality of the exercise of the foresight function.

The foresight function in transport is equivalent to how the system needs to be prepared to meet the demands of the society in terms of quantity and quality. This is a problem of balance in the context of a permanent dynamic of supply and demand that must constantly adapt to the formulated demands.

Knowing the socio-economic evolutions can lead to economic sizing of transport system's constructions and installations to satisfy the demand with minimal resource consumption. It is knownthat the greatest waste of resources is encountered in transportation, whether due to internal causes that are not sufficiently studied (management of empty vehicles, systemic incompatibilities, geographic separation requiring different transshipment / gauge, correlation of schedules, interdependence in traffic charts, etc.), or due to external causes and environmental influences (goods that are not on time, nonrespecting the schedules, unfavourable weather conditions, quantities of goods not in line with initial planning etc.).

The necessary data in the forecast are data regarding the evolution of the system and the factors that determined it. The used methods are those specific to statistical analysis, in uncertainty conditions, which allow to establish probable areas of values of some indicators, based on dynamic series analysis, regression analysis etc. [7]. Unfortunately, there is no way to determine by objective calculation the type of curve that best approximates the dynamic series available [8]:

The choice of the type of function that most accurately describes the known values is made by the curve aspect obtained by graphic representation of the observed values taking the time on the abscissa.

After choosing the function, its coefficients are calculated by the least squares method called the regression method.

The chosen theoretical curve best describes the observed values when the sum of squares of thedifferences between the observed values and the calculated theoretical values is minimal. But the sum is minimal when the first derivative is zero, so, by doing the partial derivatives with respect to each of the unknown parameters, a system of equations from which these parameters can be calculated is obtained. The right to use the least squares method is demonstrated by the principle of maximum verisimilitude from probability theory.

APPLICATIONS OF TRANSPORTATION FORECASTING

Transportation forecasts can be utilized in a variety of different situations and with different modes of transport, from estimating traffic volumes on a specific segment of road or highway, to estimating ships in a port, or passenger volumes on a city's buses.

Traffic forecasts help to explain what the needs of the future might be and provide benchmarks for proper design and efficient transportation system operation. Example applications of forecast information include:

- Development of infrastructure capacity and design calculations (e.g., the operations of an existing or proposed roadway or bridge, or the thickness or type of roadway pavements)
- Estimation of the financial and/or social viability of projects (e.g., developing benefit-cost analyses and/or social impact assessments)
- Calculation of environmental impacts, such as air and noise pollution

BENEFITS OF TRANSPORTATION FORECASTING

Transportation forecasting solutions ensure that logistics, manufacturing, and supply chain are executing to the same plan. Transportation and warehouse planners have visibility into promotions so they can plan for spikes in demand, reducing their reliance on the spot market and enabling more accurate staffing.

Although premiums are not high now, transportation is a cyclical business and rates will rise as capacity has dropped and business is improving. Manufacturers can increase intermodal shipments and decrease deadhead miles with the ability to plan for increased demand weeks in advance of actual orders. Switching to intermodal shipments reduces carbon emissions and fuel consumption, decreasing costs and improving sustainability efforts. Visibility into future transportation requirements enables manufacturers to identify capacity issues in advance, giving logistics the time to resolve them. Visibility into future shipments and receipts improves warehouse staffing. Separating truck procurement from order creation both lowers costs and improves responsiveness. Forecasts that match current manufacturing and distribution capabilities and strategies generate more effective strategic sourcing and give manufacturers the opportunity to collaborate with carriers and retailers, benefitting manufacturers, retailers, carriers, and consumers.

Transportation forecasts can be integrated with Transportation and Warehouse Management Systems to further improve efficiency. Manufacturers can cut costs, improve service, and increase sustainability by forecasting transportation requirements rather than just reacting to orders.

CONCLUSION

Travel analysis and traffic forecasts occur and are important inputs in developing infrastructure – from guiding the overall transportation policy, to informing planning studies and the engineering design of specific projects. A successful transportation forecasting solution must generate a forecast that is not only tied to the corporate demand plan, but also provides the granularity required by transportation— for example, mode, protection class, carrier, etc. The sequential and aggregate nature of transportation forecasting has come under much criticism. While improvements have been made, in particular giving an activity-base to travel demand, much remains to be done.

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