

PHYSICAL SYSTEMS MODELLING AND ANALYSIS OF  
SOCIAL SERVICE SYSTEMS

by

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CERTIFICATE

Certified that the thesis entitled, 'Physical Systems Modelling and Analysis of Social Service Systems', which is being submitted by Mr.P.K.Baakar for the degree of Doctor of Philosophy in Electrical Engineering of the Indian Institute of Technology, Delhi, is a record of the students' own work carried out by him under my supervision and guidance.

The matter embodied in this thesis has not been submitted for the award of any other degree.

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ABSTRACT

Certain basic concepts and postulates of the linear graph based network theoretic physical systems construct, which has emerged in recent times as a powerful general interdisciplinary approach, are being suitably generalized to encompass a variety of socio-economic systems, such as national economy, educational system etc. In the present research an effort has been made for its further appropriate generalization and extension to two of the social service systems namely, national transportation system and community health care delivery system in terms of their successful dynamic modelling and analysis. One hallmark of the research studies in this thesis is the conceptualization and operationalization of a nested two-level hierarchical or recursive systems engineering approach, which treats the transportation system as an embedding in the supra-activity system.

In dynamic modelling of the national transportation system it is important to recognize that the transportation system which is provided affects the way in which the socio-economic system grows and changes, while the changes in the socio-economic activity system in turn call forth changes in the transportation system. This two-way interdependence is fundamental to systems view point in this

research, where a transportation system has been regarded as a subsystem of the comprehensive activity system.

While its own analysis the dynamic national economic activity system model, which subsums an aggregate representation of the transportation sub-system, generates time-paths of the inter- and intra-regional flows of goods and passengers. These flows act as 'flow drivers' for the transportation system state model at the appropriate terminal pairs and permit complete analysis of the detailed transportation system for the various link flows and 'costs' of transportation. These resulting equivalent 'costs' of transportation are fed back into the economic model for analysing the inter-related price model of the activity system.

The national economy and transportation sub-system are identified here as a collection of interconnected components, whose terminal characteristics embody various economically meaningful parameters and transportation system factors. From the component terminal equations and their interconnection pattern a state model for the system, representing various flows and prices, is developed.

In the specific context of India, the two-level system theoretic construct is empirically tested at a level of disaggregation corresponding to two geographical

regions and three functional sectors in each region and features an aggregate equivalent representation of transportation network in terms of its supply function for the supra-activity system on one hand, while on the other the transportation subsystem network is conceived of as consisting of nineteen links and eleven nodes.

With regard to the relatively minor research project, a community health care delivery system has been viewed as a trial of health need, demand and resources in terms of a network theory based physical systems modelling framework. Patient state concept is introduced through which the efficiency of a health unit can be judged. It is believed that the resulting state model is empirically implementable in so far as a real-life health-service system represented by the sick bay at I.I.T.Delhi provides the back-drop for system conceptualization in this research.

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