OPRE 6398.001 Prescriptive Analytics

Reading 8*

General Telephone (GTE) maintained over 2,600 central offices serving more than 15.7 million telephone lines at the time of this study. All telephones are physically connected to central offices, which in turn are linked to a network of other central offices. The connections are primarily copper wires, but can also consist of electronic remote units, electronic switching units, and fiber-optic cables. Each of these requires additional support facilities such as underground ducts, telephone poles, and special buildings.

Marketing forecasts of future demand indicate when present capacity will be inadequate, triggering a need for new construction. Planners then evaluate feasible alternatives along with the associated costs to determine the best expansion strategy, which seeks the locations, sizes, and timing for facilities to meet projected requirements at minimum discounted costs.

Network planning at GTE was fairly straightforward when only copper cable was used. Digital technology became available in the early 1970s complicated the problem a great deal, however. In 1987, it was proposed that a sophisticated network optimization tool be developed to automatically produce a cost-effective plan to guarantee sufficient capacity to serve all customers over a 10-year period. A major project was undertaken to address the problem, making sure that the planning staff well understood the various technological, policy, and regulatory constraints. The end product of the study was the NETwork Computer Aided Planning (NETCAP) model, which enabled planners to get simple maps of existing facilities on their computer screens with forecasted demands, years, and sites where insufficient capacity was expected. The new system was delivered at the end of 1988.

Users were impressed with the speed and quality of NETCAP, in which the algorithms were applied in a series. An original solution decomposed the problem into first determining the optimal locations for multiplexing devices and homing arrangements to minimize the costs of satisfying this year's demand. The second problem was to determine the optimal schedule for installing remote units and expanding cable capacity. These two subproblems were imbedded into an interactive optimization procedure and near-optimal solutions were obtained in three to 10 minutes.

NETCAP was credited with improving productivity at GTE by more than 500 percent, resulting in savings of over $30 million per year in network construction costs. Planners were extremely positive about the system's flexibility and found it very easy to use.

* Adapted from Jack, C., Kai, S.-R., & Shulman, A. NETCAP--An interactive optimization system for GTE telephone network planning. *Interfaces*, 1992, January-February, 72-89.