Chapter I

INTRODUCTION

1.1 Introduction

We describe in the sequel some of the important problems and their solutions in the area of facility locations. There are broadly two types of work that pertains to the field. One is deterministic and the other includes probabilistic considerations. Our work in this thesis belongs to the first category. The purpose of this introductory chapter is to narrate the various work of authors relevant to our investigations in the thesis. We not only bring forth the salient features of the work in the facility location problem area but also delineate the motivation and importance of the work carried out by us in either complimenting or completing some of the past investigations.

There are, in general, in the literature pertaining to multifacility location problems three measures which are often used. The first one is the rectilinear distance between locations which is defined as follows: If $P(x_1, y_1)$ and $Q(x_2, y_2)$ are two locations in the Euclidean plane then the rectilinear distance between them is defined as $\overline{PQ} = |x_2 - x_1| + |y_2 - y_1|$. The second measure is the ordinary Euclidean distance between them, viz.,

$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} .$$

The third one is the squared Euclidean distance between them

and it is $PQ^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$. The realistic problems corresponding to all these measures are usually weighted and the objective function is in general a sum of all the weighted measures. Extra constraints may be present according to the situation considered. The weights may be deterministic or probabilistic in nature. The locations of existing facilities may be some specific points forming a network etc., or simply any given points in the plane. In the literature one comes across various names given to these problems such as, the generalized Fermat problem, the p-median problem, the generalized Weber problem or Steiner problem etc. When one uses the squared Euclidean distances the problems are often called 'quadratic facility location problems' or the 'gravity problem'. The use of the word gravity is justified because the centre of gravity of the weighted locations is the minimum solution. For convenience we group in the sequel the topics under narration as (a) Static deterministic models, (b) Dynamic models and (c) Probabilistic models.

(a) Static deterministic models

We deal first the case when the existing facilities are given points in the plane but are not constrained to be points on a lattice or network etc. Next we describe the work where the existing facilities are specified as points on a graph etc.

(i) Facility locations are general points

Baumol and Wolfe (1958) have discussed a method for