Dedication

To my wife. I also extend my dedication to Ghaza Children hoping an end to their suffering.

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Prof. Galal A. Ali for his guidance and continued support throughout this research study. I would like also to thank the Directorate of Transport and Traffic at the Ministry of Urban Planning and Infrastructure and MEFIT Consultant.
The goal of this research is to model traffic flow in Khartoum City using four-step model (FSM): trip generation, trip distribution, modal choice and trip assignment. In the first stage, the trip production and attraction were determined. In the second step, the traffic flow distribution among zones was considered. Thirdly, graphical relationship for probability to choose mode were developed.
The last step dealt with distribution of traffic along routes by the method of Bureau of Public Roads (BPR) which is compared with Davidson procedure. The comparison was favorable with percentage difference not exceeding 8% result indicated.
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**Abbreviations**

- **TAZ**: Traffic Analysis Zones
- **ES**: External Stations
- **TS**: Transportation System
- **AS**: Activity System
- **FSM**: Four Steps Model
- **P<sub>i</sub>**: Production from zone i
- **A<sub>j</sub>**: Attraction to zone j
- **NHB**: None Home Base
- **HBW**: Home Base Work
- **HBO**: Home Base Other
- **HBE**: Home Base Education
- **T<sub>Q</sub>**: Travel time (min) at volume Q
- **T<sub>0</sub>**: Travel time at zero flow
References

2. MEFIT (Khartoum Transport and Mobility and Planning), Khartoum State, Sudan Feb 2010
3. ITE Journal, Transportation Planning, May 1995
5. Prof. Kanafani, Transportation Planning University of CEE, 2001