CHAPTER 8

CONCLUSION

> If we offend, it is with our good will, that you should think, we come not to offend, but with good will. To show our simple skill, that is the true beginning of our end. Shakespeare [54].

The research has attained a measure of achieving the formal objective of the work as set out and implied in the first chapter of this thesis, i.e. to address and investigate the phenomenon of congestion as and where it occurs. One may categorically state that such an investigation could hardly have been attempted without using the methods of analysis established by previous human generations, albeit that such method only emerged from an embryonic state after the Middle Ages.

The field of study which would attract the attention of theorists was Queueing Theory which would develop over the past century by leaps and bounds. The analytical investigation of stochastic processes has continued unabated up to the present time. The adjectival use of the term “stochastic” means that a probability function is generating an ordered sequence of events which in the context of Systems of Congestion means that the ordering is usually related to time.

The goal of the thesis as described in Chapter 1 has been to develop analytical skills related to real-world systems. The worth of models is then measured by their utility in dealing with real practical systems rather than by their mathematical elegance.

Chapter 2 deals with the necessary introductory matter of parameter estimation of the random phenomena of stochastic models. The methods used are demonstrated in respect of two queueing models which are subjected to inference investigation. The essence of the chapter lies therein that the value/accuracy of a model must be established in a prescribed fashion.

Chapters 3, 4 and 5 of the thesis demonstrate how system characteristics are determined for three selected Systems of Congestion and how model usefulness may be assessed. The systems are modelled via the classical birth-death postulates which are adapted to fit the particular system configuration.

The models offer closed-form steady state solutions and transient analysis of system behaviour in response to sudden changes in input or service capabilities. Notwithstanding their elegance the resulting equations are overly complex for use by an average practitioner, or too cumbersome or awkward for useful manipulation. This statement may be supported by referring to the case of a simple M/M/1 queue which is the most “easily” solved of all queueing models. To initially find the transient solution, and once available, to use the solution, is sufficiently daunting to discourage all but curious and skilled practitioners from further exploration.

The contention may consequently be expressed that even if closed-form models may be created, and that they may be used with considerable computational burden, it is prudent to resort to simulation studies in an attempt to conveniently analyze the time varying behaviour of Systems of Congestion.

Chapter 6 attempts to emulate the generation of an ordered sequence of arrival and service events for simple queues via Chaos-based generation of arrival and service orbits, which orbits are then used to model the dynamics of the system population via a sequence of model iterations. <u>The chosen modelling method, which inter alia makes use of “designer equations”, achieves acceptable performance without the fuss and bother of intricate and tedious manipulation.</u>

Chapter 7 extends the applicability of the modelling approach to more practical and complex real-life Systems of Congestion and indicates how system congestion may be alleviated by modifying the system under consideration via a symbiotic partnership between model and modeller. Manipulation of the selected models is emphasized by spreadsheet iteration results which graphically exhibit the system dynamics as a matter of course.

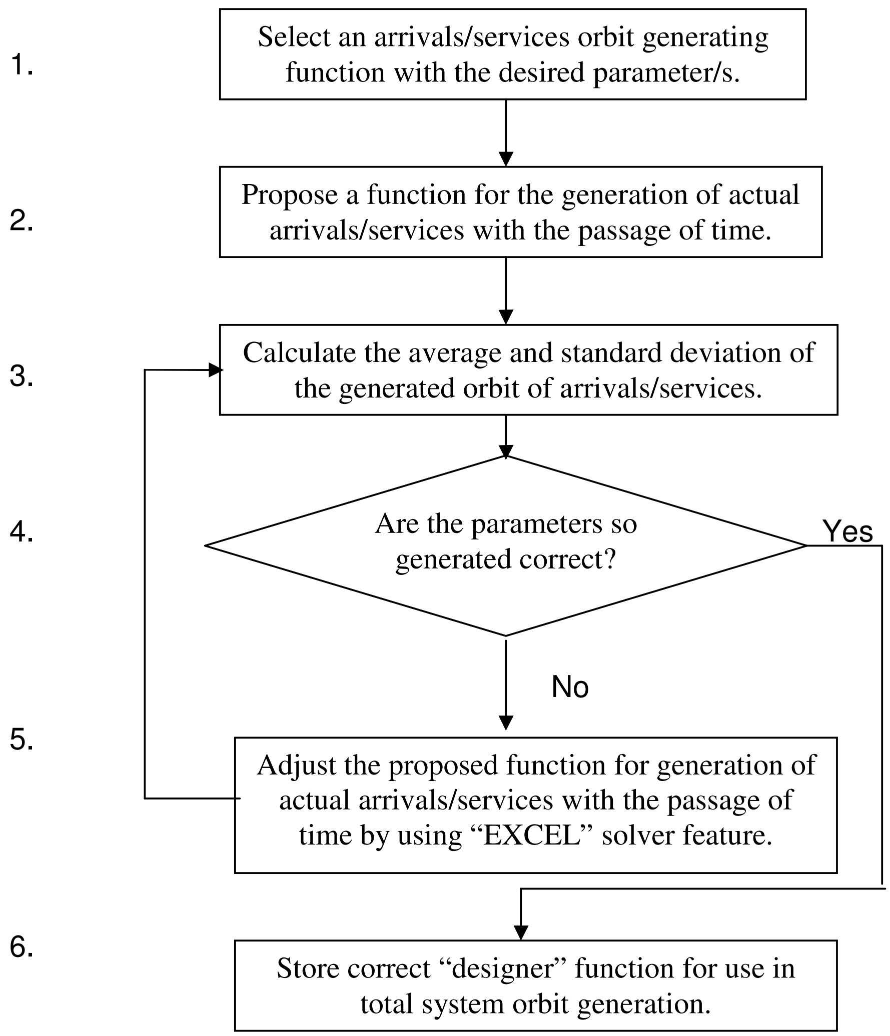
Construction of an iterative dynamical system model requires that a practitioner should:

- comprehend the structure of the System of Congestion in its entirety,
- place the necessary emphasis on those facets of the system structure which must be modelled accurately,
- identify those facets of the system structure which cannot significantly affect the system dynamics,
- assemble the available data on system operation and manipulate such information so that it proves to be useful during model iteration,
- assess how and where interaction with the modelled system may via amendment be most beneficial,
- select suitable methods of system orbit generation,
- ensure that the required designer equations are employed to shape the system orbit, and
- finally construct a desired system operation objective (minimize waiting time, minimize total system entities, maximize system "efficiency", maximize customer pleasure etc.) by means of manipulation/adjustment of the system structure.

In conclusion one may submit the supposition that searching for robust simple models which deliver credible and useful solutions to complex design and operation problems of Systems of Congestion does have considerable merit.

APPENDIX A

Flow diagram for the design of an arrivals/service orbit generating function.



APPENDIX B

Flow diagram for the design of a system orbit generating function.