

A parsimonious agent-based emergency call centre model

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Statement of Originality

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DEDICATION

Dedicated to our children and grandchildren

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Abstract

A parsimonious agent-based emergency call centre model

by Bruce Graham Lewis

This thesis presents an agent-based model of an emergency services call centre. The original contribution of this thesis is to demonstrate that agent-based modelling can be used to simulate the operation of an emergency services call centre. The thesis demonstrates that a simple calibrated parsimonious agent-based computer model of an emergency call centre is capable of simulating a real emergency call centre by directly emulating the interaction between the call queue and the customer service representatives who service the calls.

The model is parsimonious in that it looks at the interaction between inbound calls and servers with a manager and without modelling the call centre technology or other agents. It was designed to run at a simulated one second resolution and results are available at any time during or at the end of a simulation run. This level of resolution was not found in models reported in the literature.

The New South Wales Police Assistance Line in Australia (NSWPAL) was the first of its type in the world for the reporting of urgent and non-urgent crimes and incidents, and is used as a case study in this thesis.

The thesis presents the first detailed research analysis of police emergency inbound call queues and the first detailed research analysis of the NSWPAL emergency and non-emergency queue data over a four year period is presented. The model's servers' parameters were calibrated against the NSWPAL data.

A number of experiments demonstrated the model's utility including showing differences and anomalies in the methods used to calculate service level, the impact of talk time on performance, the differences in call allocation methods, the impact of unexpected exogenous events, the use of historical data to examine past performance and the differences between the thesis and Erlang C models.

PUBLICATIONS FROM THIS RESEARCH

The following were published in conference proceedings and journal publications:

- Lewis, B., Herbert, R. and Chivers, W. (2010), ‘Modelling Service Levels in a Call Centre With an Agent-based Model, *World Review of Science, Technology and Sustainable Development* 7(1), 212.
- Lewis, B. G. and Herbert, R. D. (2009), Simulating the Call Streams to an Emergency Services Call Centre, in ‘The 6th International Conference on Information Technology and Applications, International Conference on Information Technology and Applications, pp. 259264.
- Lewis, B. G., Herbert, R. D. and Chivers, W. J. (2008), Modelling Service Levels in a Call Centre with an Agent-Based Model, in ‘Proceedings of the 5th International Conference on Information Technology and Applications, IEEE, pp. 426430.
- Lewis, B. G., Herbert, R. D., Summons, P. F. and Chivers, W. J. (2007), Agent- based Simulation of a Multi-queue Emergency Services Call Centre to Evaluate Resource Allocation, in L. Oxley and D. Kulasiri, eds, ‘MODSIM 2007, International Congress on Modelling and Simulation., Modelling and Simulation Society of Australia and New Zealand, Modelling and Simulation Society of Australia and New Zealand, <http://www.mssanz.org.au/MODSIM07/authorsL-M.htm>, pp. 11 17.
- Lewis, B. (2006), The Application of Computer-Based Modelling to the Management of Multiple Queues in an Emergency Services Call Centre, in ‘Proceedings of the Research Higher Degree Students Congress 2006, School of Design, Communication & Information Technology, University of Newcastle, Callaghan, Australia, pp. 3237.

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GLOSSARY

131444	The NSWPAL telephone number customers call for non-urgent matters.
ABM	Agent-Based Model.
ACW	After Call Work. This is also known as wrap-up time (Koole, 2007). It is the additional time an agent spends on a call after the call with the customer has ended.
AHT	Average Handle Time. It consists of the call talk time and the ACW.
ASA	Average Speed of Answer.
AWT	Acceptable Wait Time (Koole, 2007, Essafi and Bolch, 2005). The time within which a business or organisation would like all of its telephone calls to be answered ¹ .
CSR	Customer Service Representative.
CTA	Call Taking Agent. This term is used in the program code to distinguish the model agents from the human CSRs.
CTI	Computer-Telephony Integration.
ESO	Emergency Services Organisation.
GUI	Graphical User Interface.
IBM	Individual-Based Model.

¹ Based on the researcher's experience in the call centre industry

NSWPF	New South Wales Police Force.
NSWPAL	New South Wales Police Assistance Line.
OOD	Object-Oriented Design.
OOP	Object-Oriented Programming.
Service level	The percentage of calls a business or organisation deems acceptable to be answered within the AWT. Although there is no standard for this, 20% is seen as representative for non-emergency call centres and 10% for emergency call centres ² .
TSF	Telephone Service Factor. See Service level above.
Triple Zero (000)	The Australia-wide emergency telephone number for Police, Ambulance or Fire Brigades.

² Based on the researcher's experience in the call centre industry