Technology Strategy Board
Driving Innovation

Knowledge Transfer Network
Industrial Mathematics

Keeping things moving

INTEGRATED MODELLING OF ASSET MAINTENANCE AND SUPPORT

LSC Group Ltd / University of Salford

The need

The more resources that are employed, the greater the operational scope of the military asset - in reality, funds are limited. The question then becomes 'how do we decide where to allocate funds to return the greatest operational capability?'

The collaborating company, LSC Group, is undertaking an R&D project called 'Deployable Decision Support Environment' (DDSE) to create an integrated modelling environment for the prediction of through life support characteristics of capital assets.

An assessment of the 'trade-off' between the ranges of asset capabilities and their predicted costs is required in order to find feasible operational strategies best suited to address likely operational situations.

The outcomes

In this project, there was scope for increasing the fidelity of the information upon which decisions will be made by employing mathematical models to capture the complex interactions between decision variables.

In the assessment of Through Life Costs within the decision environment, this internship project embedded novel models of failure and repair from reliability theory within a discrete event simulation model of a military deployment used to analyse the availability, reliability and maintainability requirements of a system through its operational life.

The project has provided LSC with the ability to assess the feasibility and value of a tool to examine different repair and replacement strategies, which can be deployed in response to changing operational circumstances. This capability is intended for use by unit/fleet commanders in the field, who will be able to explore operational benefits and the costs of different maintenance strategies and actions.

The work also fed into the cost-capability optimisation development programme which also is part of the DDSE project.

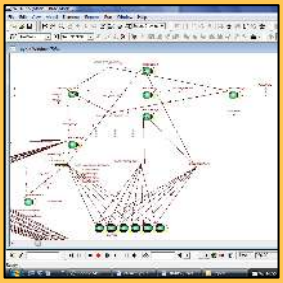
"By combining [Rhys's] research with LSC's domain and system knowledge we have taken forward the thinking and [the] design of simulation. The results of these investigations provide optimised solutions to be recommended."

Peter Jackson
LSC Group

Technical summary

The combined modelling environment was developed, with a military deployment of land based vehicles as a test case: A troop of vehicles on deployment may undertake missions of varying nature for which spare parts must be carried to repair any systems which might fail whilst away from base.

The investment required in spare parts and manpower required to undertake preventive maintenance tasks of the fleet to allay failure were the cost factors considered for the model. The performance of the fleet under different strategies was measured in terms of operational cost, fleet utilisation, and the rates vehicles returned successfully from mission.



The modelling was undertaken in a discrete event simulation package (Witness [1]) incorporating analysis of spare-part supply line delays. Rather than use exponentially distributed failure rate or renewal processes to simulate the system failures, age-dependent intensity processes [2] were coded within the software package enabling the assessment of the effects of an increasing likelihood of failure with age on fleet performance. The reliability of each vehicle was also conditioned on its maintenance history and the load it had experienced whilst undertaking missions on varying types of terrain to provide greater realism in the assessment of the integrity of the data.

[1] http://www.lanner.com/

[2] D F Percy and B M Alkali (2006) Generalized proportional intensities models for repairable systems. IMA Journal of Management Mathematics, 17, 171-185.

"It has been a really great experience being able to take my research and contextualise it within an industrial application. I believe the validity of my PhD work will be improved by the insights I have gained ... I now feel better prepared for life post PhD…"

Rhys Kearney, University of Salford

"... this internship with the LSC Group provided Rhys with an excellent opportunity to experience the practical aspects of implementing some of these methods in a commercial environment. His enhanced understanding of repairable systems and maintenance processes will serve him very well …"

David Percy, University of Salford

This project was part of the programme of industrial mathematics internships managed by the Knowledge Transfer Network (KTN) for Industrial Mathematics. The KTN works to exploit mathematics as an engine for innovation. It is supported by the Technology Strategy Board, in its role as the UK's national innovation agency, and the Engineering and Physical Sciences Research Council, in its role as the main UK government agency for funding research and training in engineering and the physical sciences.

EPSRC
Engineering and Physical Sciences Research Council

Project Details

Partners

LSC Group Ltd
University of Salford

Project investment

£12,000

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