QMIH&S Conference Paper 2009
Conference Theme: Safety & Health – everyone's business

Using the Operability and Maintainability Analysis Technique to understand equipment design issues

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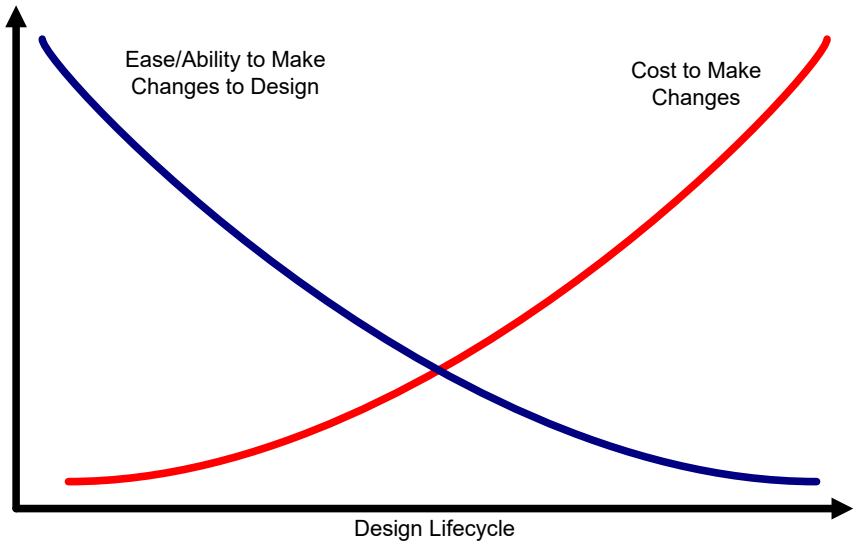
PART 1: Background of OMAT

This paper will outline an application of a risk assessment tool developed for use in relation to mobile mining equipment called the Operability and Maintainability Analysis Technique (OMAT). The original concept of OMAT came from a multi-company industry initiative called the Earth Moving Equipment Safety Round Table (EMESRT). The aim of the initiative is to engage Original Equipment Manufacturers (OEMs) to improve the safety of Earth Moving Equipment by making design changes at the concept, design and manufacturing stages of the equipment lifecycle. It is intended that this will accelerate the development and adoption of leading practice designs that minimise risks to health and safety.

EMESRT regards operability and maintainability as major design challenges for improving human interaction with mining equipment. Ultimately, the implementation of a comprehensive equipment review process, including operability and maintainability, initially implemented at all design phases, build phases, initial site operation and finally post retrofit, will ensure that all critical design issues related to tasks are addressed throughout the asset lifecycle. Ideally, issues would be identified and addressed at earlier stages where it is much easier and of lower cost to modify designs:



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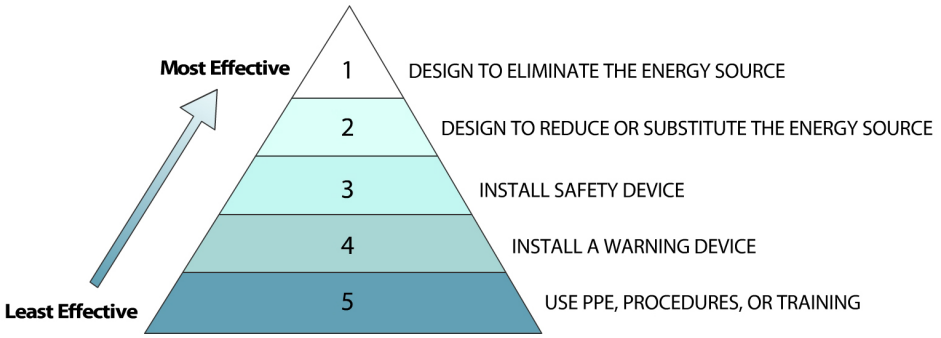
To assist OEMs with the systematic review of new and existing equipment design, EMESRT developed the concept of an Operability and Maintainability Analysis Technique (OMAT). In 2008, with funding provided by ACARP, MISHC further developed and evaluated OMAT for its ability to identify, prioritise and eliminate or mitigate potential safety issues associated with earth moving equipment. Site trials were undertaken on haul trucks, with participation by two different OEMs. Subsequently, two mining companies have applied OMAT key identified issues.

OMAT combines qualitative risk assessment for problem prioritisation and tasks analysis. It is through the task orientation of the tool that it attempts to include the human factors issues associated with operating and maintaining equipment. It also incorporates the concept of ALARP, or **A**s **L**ow **A**s **R**easonably **P**racticable, through the use of the Hierarchy of Controls. Consideration is given to recognised standards when identifying control measures, but thinking about how best to mitigate risks goes far beyond the use of standards.



Though these concepts are not new it does provides a well thought out structure of integrating these concepts that is thought to lead to rigorous analysis of the risks involved, minimising shortcuts and making assumptions. This means that the qualitative results from a tool like this will likely be more reliable than for simpler tools. Additionally, it will be easier to compare smaller details of risk controls across different modifications.

OMAT could be applied in three manners:

1. For the OEMs to assess and control safety risks during design of mobile equipment. It was developed to align with the manufacturers' stages in the Asset Lifecycle, from concept to commissioning.

2. To allow better communication between OEMs with end users about the process of risk identification and controls that has taken place. This frames engagement between manufacturers and end users. It also provides a clear basis for end users to design and implement site level controls.

3. For a mine site to assess their equipment. This may be to help make decisions about future haul truck purchasing, to investigate incidents involving mobile equipment or to audit the truck after modification.

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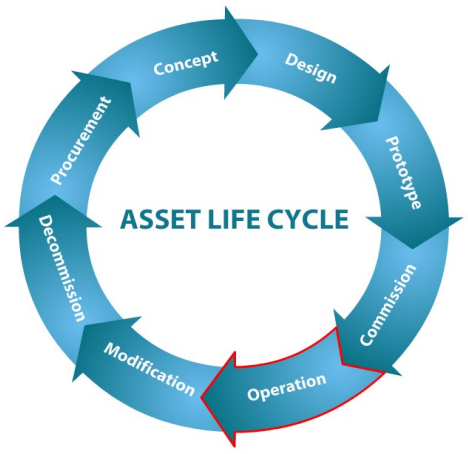
OMAT is currently a six stage process. The stages, and their objectives, are listed below:

	OMAT Step	Objective
1	Critical Task Identification	Identify the key hazards, potential consequences and frequency of task performance to give a priority order to address in further stages.
2	Task Flow Chart	Create a flowchart of priority tasks, including potential deviations, in order to further understand the task and allow risk assessment of task stages.
3	Risk Identification	Identify the inherent consequence associated with each task step, use a local risk matrix to risk assess each task stage including manufacturer provided controls and, finally, re-assess the risks with site based controls/modifications.
4	Solution Options	Identify and list possible solutions worthy of further attention that could address identified issues including a consideration of any risks/issues potentially created by their implementation.
5	Action and Feedback Plan	Document the process of considering solution options and risks identified to be further reduced. Provide feedback on the reasons for selection, or rejection of controls.
6	Equipment Risk Register	List the risks associated with the equipment and what controls are in place. This is to allow understanding of the effectiveness of the controls already in place and identify where further site based controls would be useful.

The remainder of this paper will outline how an underground copper mine has trialled the OMAT process to assist with manual tasks risk management in the design of underground mobile equipment. This case study is an example of the third manner listed above and in the operation stage of the asset lifecycle, as depicted below:



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PART 2: Details of Site Application

The OMAT was conducted in the 20 secondary (Underground) level maintenance workshop at Mount Isa Mines' North Queensland U/G Copper Mine Operation. The focus of the assessment was maintenance (Diesel Fitter) tasks while performing maintenance on LHD (Mucking Unit) earth moving equipment.

The Goal of the OMAT was to identify which tasks and task components may be contributing to the development of musculoskeletal disorders (acute and cumulative in nature) during maintenance operations (proactive and repair) and the role of the equipment's design in those tasks. This information would then be included in the development of Manual Tasks Design Philosophies (DP) being developed for EMESRT U/G hard rock technical working groups.

The equipment focused on was a TORO (Sandvik - OEM) OMAT was conducted in an operating maintenance workshop, with 6 Diesel Fitters, a maintenance supervisor and 2 x Occupational Therapists. The assessment was conducted over 2 x operating shifts and involved observation of regular proactive maintenance (Weekly checks), and an Engine refit.

There were a number of issues identified during the OMAT which related directly to the design of the equipment. Amongst the issues identified, access, egress, awkward and static postures, and high force exertions (manual and energized tool use) the primary contributing factor was restricted equipment access. Restricted access to allocated maintenance area include accessing hydraulic hose compartments (As below), driveline checks (as below), wiring checks (as below), fuel line checks, mounting bolt instillation and removal (as below) and transferring (access/egress) to and from the unit. Each of these tasks were characterized by medium-long duration exposure to static moderate intensity exertions, awkward postures (including static), and manual tool use (energized fittings were too large to be used).

Figure 1: Wiring Checks

Figure 2: Hydraulic Hose Bay Access

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Figure 3: Engine Mounting Bolt Removal

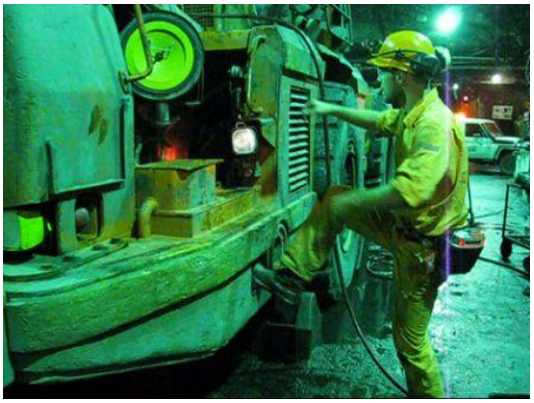

Figure 4: Rear Access Point

Strengths

The OMAT tool presents a risk assessment resource that facilitates a large and complicated process in one format. The 6 step process presents an outcome that incorporates all the data that has been collected and allows informed and logical decisions to be made about injury management control strategies.

The modifications made to the original OMAT, allowed the assessment and characterization of manual task risk factors that related specifically to maintenance activities conducted on TORO LHD units.

The amalgamation of Task identification, risk assessment, solution options, and documented action plan processes within one tool provides a dynamic tool which presents a rich and targeted catalogue of information that can be communicated to the manufacturer.

Limitations

The primary limitation with the OMAT tool is the time required to successfully conduct the assessment. While the tool is an outstanding resource that facilitates a large process, it requires a comparable time and resource commitment to conduct.

Planned Action

The goal of the assessment was to identify which tasks and task components may be contributing to the development of musculoskeletal disorders (acute and cumulative in nature) during maintenance operations (proactive and repair) and the role of the equipment's design in those tasks. This information would then be included in the development of Manual Tasks Design Philosophies (DP) being developed for EMESRT U/G hard rock technical working groups.

Our plan moving forward will include Incorporation of the results into the development of Manual Task Design Philosophies (DP's) for EMESRT and communication of the results to Sandvik through EMESRT.

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Locally at site we will communicate and Implement control measures identified with the workplace and incorporate the risks we have identified into our broader manual tasks risk management strategy to continue working towards our goal of zero harm.

PART 3: Inquiries and Further Information

The uptake of OMAT is increasing. EMESRT welcomes industry partners, including OEMs and end users, who are interested in applying the OMAT process to their own equipment. Participation in this way will assist with the further development and evaluation of OMAT.

For inquiries regarding OMAT please contact Tristan Cooke at t.cooke@mishc.uq.edu.au.

Further details on EMESRT can be found at the following websites:

Access the EMESRT DPs at http://www.mirmgate.com/

Download the EMESRT CD at http://www.mirmgate.com/emesrt.asp

Register for EMESRT Alerts at https://www.mirmgate.com/alertservice/alert_service.asp

Subscribe to MIRMgate News at http://www.mirmgate.com/mirmgate_news.asp

Access TYREgate at http://www.mirmgate.com/tyregate/

To contact EMESRT please email emesrt@mishc.uq.edu.au

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