Design of control panels for underground mining equipment: Why open innovation should be promoted as a sustainable approach to development

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Introduction: Control panels of mining vehicles in service suffer from several ergonomic deficiencies (Horberry and Cooke 2012, Nadeau et al 2013, Boudreau-Trudel et al. 2014a). Fully automated vehicles will not likely be the norm in Canada in the near future. The goal of the present study was to document current ergonomic problems in the cabins of drillers and bolting machines used in Québec deep mines. A human digital modelling study has provided data on clearance and accessibility problems from a macro perspective (Roque et al. 2014). Here we examine more closely the problems with the control panels of another driller and bolting machine.

Method: We measured dimensions inside the cabins of a driller and a bolter used in two mines in the southwest portion of the province (Abitibi-Témiscamingue): displays, control knobs, push buttons, levers and lights and so on, the spaces between them, console height, and space for the operator.

Using results documented in the literature, MIL HDBK 759C and MIL STD 1472F, we propose recommendations for the design of controls and displays (positions and dimensions).

Results: We examined more closely the problems with the control panels of a driller (Figure 1, 2) and a bolting machine (Figure 3, 4). We have noticed sharply inclined consoles, a panel located at an angle of 90° from the front console, confusing appearance of controls, controls spread out over the entire panel, incomplete or absent controls identification, indicators too close together. The current design of these panels introduces possibilities for human error, musculoskeletal lesion and other undesirable occurrences.

![Figure 1: The front control console of the studied driller](image1)

![Figure 3: Front control console of the studied bolting machine](image3)
Discussion: The literature suggests various approaches to correcting this condition (Burgess-Limerick 2010, Cloete et al. 2012, EMERST 2012, Steiner et al. 2013, Steiner et al. 2014). However, we have not found any analysis of the costs of implementing these recommendations in terms of the expected benefits. Where vehicles are concerned, mining companies generally purchase off-the-shelf technology. The design of safer mining vehicles would benefit from knowledge sharing, improved industrial practice, open innovation and collaboration with experts in sustainable development.

Keywords: Underground mining, bolters, drillers, dashboards, open innovation, sustainable development

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