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# Safe design of mobile equipment traffic management systems

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ABSTRACT

Designing and implementing safe, efficient and operator-centred traffic management systems for mobile equipment, other vehicles and pedestrians is of key importance in almost every industrial domain. Such systems rarely develop successfully on their own; whilst standards and guidelines do exist, they are often not stringently and comprehensively employed in all industrial settings, and additional guidance to managers responsible for traffic management would be beneficial.

Building on models of the elements required for effective traffic management, the work described in this paper used a review of the literature, case studies from a variety of different industrial domains and operator-centred safe design processes to develop a set of 50 human element questions to help ensure mobile equipment safety. The process was iterative, and involved subject matter expert feedback, trialling the draft question set in an audit of several sites following a major incident and incorporating emerging findings about the possible use of new assistive technologies (such as collision detection systems).

*Relevance to industry:* In terms of industrial applications, the resultant question list can be used to identify potential problem areas, primarily safety but also partly inefficiency, regarding mobile equipment interactions with pedestrians, infrastructure or other equipment. Potential problem areas revealed could then undergo more detailed investigation and possible correction using risk assessment techniques or similar.



## 1. Introduction

The issue of particular concern in this paper is mobile equipment used in industry. Such mobile equipment includes haul trucks, bulldozers, forklift trucks, mobile cranes, water trucks, rail vehicles, road vehicles, such as cars and light trucks, motorised hand trucks and other specialised industrial vehicles powered by motors or engines (Larsson et al., 2003; Horberry et al., 2010).

In this introductory section, the production benefits and safety problems that such equipment typically brings to the industrial domain will first be summarised. Following this, the need for good traffic management of this equipment will be introduced. Methods to help achieve good, user-centred traffic management will then be noted: in particular focussing on Safety in Design approaches and the use of the Haddon ten injury control strategies (Haddon, 1973). This directly leads to the purpose of this work in terms of developing a series of operator-centred questions that need to be considered in the development of almost any traffic management system.

### 1.1. Production benefits and safety problems with mobile equipment

Mobile equipment offer many benefits, such as improving work efficiency or reducing manual handling, but they can also pose a major occupational hazard. As a very general example of the scale of the issue across all industrial/occupational settings, each year in Australia, there are over 70,000 compensation claims and around 200 deaths involve workplace machinery, appliances, tools and equipment (National Occupational Health & Safety Commission (NOHSC), 2003). Similar figures also occur in other industrialized countries.

Pedestrian workers often operate in close proximity to such mobile equipment in many industrial workplaces. These pedestrian workers are typically either moving to or from workplaces at times of shift commencement, shift termination or during breaks, or they are undertaking tasks in the workplace that cannot be conducted by mobile equipment or automation, such as maintenance, preparation or quality control. Most industrial mobile equipment such as bulldozers or trucks are heavy, relatively fast-moving and powerful, and in comparison to cars used on public roads they are not explicitly designed to be crash tolerant if they come into contact with pedestrians or lighter vehicles (Larsson and Rechnitzer, 1994).

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