Development of a Systems-Based Human Factors Design Approach for Road Safety Applications

Gemma J.M. Read[1], Paul M. Salmon[2], and Michael G. Lenné[1]

[1] Human Factors Group, Accident Research Centre, Monash Injury Research Institute, Monash University, Victoria, Australia
[2] University of the Sunshine Coast Accident Research, University of the Sunshine Coast, Maroochydore, Queensland, Australia
{gemma.read,michael.lenne}@monash.edu,
psalmon@usc.edu.au

Abstract. Cognitive work analysis (CWA), a systems-based analysis framework, is intended to inform system design. However, there is little guidance available about how to use the framework in design. This paper identifies desirable methodological attributes for a new design approach for CWA and describes a process of refining these to a core set based on the opinions of CWA practitioners. The new design approach, the CWA Design Tool (CWA-DT), is outlined in terms of how it aligns with these core attributes. Finally, implications of application of the CWA-DT for road safety design will be identified and discussed.

1 Introduction

With increasing calls for a systems approach to road safety [e.g. 1], practitioners require accessible methods and approaches for the analysis and design of road systems. Without such approaches, the much heralded systems approach cannot be realised in road transport. This paper describes a new approach that aims to support practitioners in the application of Cognitive Work Analysis (CWA), a systems-based analysis framework, in road safety design efforts.

CWA is a framework of methods that supports the analysis of complex socio-technical systems with the aim of improving system design [2]. The framework sits within the field of cognitive systems engineering (CSE) [3]. CWA has been widely used to understand complex systems including nuclear power generation, military command and control, air traffic control, healthcare and rail. It is also being increasingly applied within road transport [e.g. 4, 5, 6]. The framework uses five phases of analysis to describe the constraints of the system of interest from different perspectives. This provides a model of the boundaries of possibilities for action in the system, as opposed to specifying the desired behaviour.

As a framework, rather than a prescriptive methodology, skill and expertise is required in selecting the appropriate CWA phases and methods. In addition, a recent review identified a need for additional design methods when designing for intentional systems, such as road transport [7]. CWA design applications have also tended to focus on the development of displays and interfaces in isolation, rather than whole system design [7]. As such, there is a need to extend the design process to support

D. Harris (Ed.): EPCE/HCII 2013, Part II, LNAI 8020, pp. 43–52, 2013.

wider system elements such as task design, function allocation, physical system design, team-based distributed working, training and procedures. The implication of this is that a new approach for using CWA outputs in design is needed to assist road designs from a systems perspective. Without such an approach, the full potential of CWA in this domain is not being realised.

Based on a review of literature concerned with human factors (HF) methods generally and CSE methods specifically, this paper presents a discussion and synthesis of the various methodological attributes required for a CWA design approach. Following this, the results from a survey study in which CWA practitioners were asked to prioritise these attributes are presented. The findings are used to determine key features of the proposed CWA Design Tool (CWA-DT).

A new approach to designing with CWA should align with accepted HF methodological attributes [8]. As part of the development of a new CWA-based design approach, the literature was reviewed to draw out the methodological attributes for consideration. Each attribute identified is outlined below with a brief discussion of the relevant literature.

Attribute 1: Creativity *(Definition: Facilitates creativity and / or innovation)*

Design is well recognised as a creative process, and this view has been echoed in the CSE literature. For example, Rasmussen and colleagues [9] suggest that design is a creative process that should not be controlled by formal, normative procedures. Similarly, Millitello and colleagues argue that design needs to be an opportunitistic and explorative process, rather than one that is structured and systematic [3]. In the face of calls for more guidance and structure in design processes, the need to maintain creativity in the design process has been stressed [10].

Attribute 2: Efficient *(Definition: Process is efficient and / or cost effective)*

Many CWA researchers and practitioners have noted the time requirements associated with applying the framework [e.g. 11, 12, 13] in particular its reputation for being time consuming and resource intensive [14].

There is a need to improve efficiency in the design process [10] and for design processes in CSE to be practical and cost effective [15]. This reinforces previous calls to ensure that the resources consumed in the analysis and design processes are proportionate to the benefits gained [16]. An efficient method that minimises time and resource allocation, including time for training, is more likely to be applied in practice.

Attribute 3: Holistic *(Definition: Supports coordinated design of all system elements, e.g. interfaces, training, support materials, team structures)*

CWA provides a holistic understanding of system functioning. A design approach following from the analysis should encompass this perspective and support a holistic design process. Socio-technical systems theory recognises the systemic nature of design; that due to the interrelatedness of system components, changes made to one aspect of a system will have effects in other parts of the system [17]. As such, designers need to consider unanticipated effects on the system before implementation, and ensure that the system is designed to cope with emerging effects over the system lifecycle.

The majority of CWA design applications have designed interfaces [7], even though it has been emphasised that an interface should not be implemented independently of other systems aspects such as team design, alarm design, etc [12]. Coherent design, where different aspects of the system are designed so that they are compatible and integrated, has been proposed to promote efficiency and to reduce errors [18].

Attribute 4: Integrated *(Definition: Can integrate with existing systems engineering processes)*

The importance of integrating the results of CSE design processes with system design and development processes has been emphasised [e.g. 15, 19]. Integration can be supported through presenting analysis findings in a manner that links to the wider system development process [19] or through CSE practitioners understanding the systems engineering process and terminology and presenting analysis contributions consistent with this knowledge [3].

Methods should be linked to broader design processes and the products of the design should be integrated into this wider process [16]. Methods should also align with, or be consistent with, existing tools and techniques [20] as a method that integrates with existing processes could be easier to learn and should be easier to apply within a systems design process [21].

Attribute 5: Iterative *(Definition: Facilitates an iterative design process)*

CSE methods are generally intended to facilitate ongoing re-evaluation and reconsideration of the problem being investigated as new information arises, or as the analyst progressively builds their understanding of the system [3]. Either the design problem or the initial design solutions may be re-framed or altered throughout the process. This is consistent with views of design as an iterative, rather than step-by-step methodology.

Iteration is required because of the complexity of the domains being analysed and in recognition of the systemic nature of design [17]. Iteration enables decisions to be amended and re-evaluated as the process proceeds [21].

Attribute 6: Reliable *(Definition: Produces consistent results each time it is applied)*

The literature on HF methods emphasises the importance of demonstrating that ergonomics methods actually work, to provide confidence in the methods [22] and to inform decision making regarding cost-effectiveness of the various methods [23]. As a rule, the focus has been on reliability and validity (see Attribute 13) as the basic objective measures of the success of a method [23, 24].

Reliability is concerned with the repeatability of results obtained from a method either between different analysts [22, 24, 25] or within the same analyst over time [24]. It is concerned with whether measurements are repeatable and accurate [26].

CSE researchers have called for design processes to be more repeatable [15], and for the methods in CWA specifically to be better defined to promote analyst reliability [11]. Developments in the practice of CWA and tools to assist analysts have begun working towards supporting consistency in analysis [e.g. 27].

Attribute 7: Stakeholder involvement *(Definition: Involves project stakeholders (e.g. designers, engineers, management) in the design process)*

Participation of stakeholders ensures that the design meets the needs for which it is required [21]. Stakeholders are those affected by, or with an interest in, the outcome of a design process. This could include people who operate in, and manage the system, as well as those involved in the design process such as analysts, designers and engineers. While users of the system are also stakeholders, for the purposes of this analysis users are incorporated in Attribute 14 (Worker / user involvement).

Stakeholders have different perspectives on the system, and different views of a design problem. Sensitising stakeholders to the different world views and concerns of other stakeholders can assist to reconcile issues arising from this [28]. The involvement of stakeholders with diverse knowledge, skills and expertise can also facilitate multidisciplinary learning and foster creativity and innovation [17]. Stakeholder participation generally encourages ownership of designs by those who will be responsible for the implementation, operation and use of the system [17].

Attribute 8: Structured *(Definition: Provides structure to the design process)*

The importance of structured and systematic methods has a long history in HF. Degree of structure has been used as a criterion to evaluate human error identification methods [29], and there are calls for more systematic methods in the CSE field [27].

A structured approach to design should provide a link between the analysis of the system and the cognitive artifacts produced in the design process. It should provide accountability in the design process and enable the specification of a clear path forward with the ability to trace and understand the reasons for decisions made further back in the analysis [30]. A structured process can improve efficiency, communication between analysts and reduce training time [14].

Attribute 9: Tailorable *(Definition: Can be tailored for different system types (e.g. intentional, causal, first-of-a-kind)*

Human factors methods generally need to be adaptable to different situations and be tailorable for unique applications. They should be applicable to complex systems and able to deal with the growing complexity expected of future systems [20]. They must also support application to specific situations [21]. Methods should be flexible to meet the requirements of the project, and possess contextual validity through being sensitive to contextual factors within the specific application domain [29]. A method that is tailorable could perhaps achieve this contextual validity.

Attribute 10: Theoretical *(Definition: Is consistent with the underpinning theory and principles of CWA)*

A specific aspect of validity (see Attribute 13) is construct validity. This is met when the method is based on an appropriate underlying theory [24], and has an internal structure that aligns with that theory [29]. To fully exploit the benefits of the CWA philosophy, a design method to be used with CWA should align with its underlying theoretical basis.

While CWA may not have a strong theoretical grounding in terms of a single theory upon which it is structured, it does draw from a number of established theoretical areas. These include ecological psychology and systems theory [11] and, in particular, socio-technical systems theory [31]. The underlying principles of CWA include the need to make system constraints visible to workers or users, to support cognitive processing at the appropriate level avoiding unnecessary workload, and to support knowledge-based behaviour in unusual, unanticipated circumstances [2]. These principles should be reflected in the design concepts and solutions developed.

Attribute 11: Traceable *(Definition: Provides a detailed record of design decisions)*

Traceability between design products and the information represented in the analysis enables testing of whether the design adequately addresses what was uncovered by the analysis [30]. Where designers have not been involved in the analysis, a traceable process enables designers to discover the rationale behind, and justification for, decisions that affect the subsequent design process [32]. A traceable process provides auditable documentation [29] enabling updating and supporting communication within the design team [16]. Materials that promote traceability can also assist integration with other system development processes [19].

Attribute 12: Usable *(Definition: Is usable for CWA practitioners, systems designers, engineers, etc)*

To be accepted by its potential users, a method needs to be usable. When considering HF methodologies, usability can be defined as the ease of use of the method [29]. A method that is usable and straightforward to learn is more likely to be selected for use in practice [21]. Usability has previously been applied as a criterion for evaluating human error identification methods [25, 29] and it has been suggested that a usable method promotes better consistency amongst analysts and less errors than one which is demanding or difficult to use [25].

Attribute 13: Valid *(Definition: Does what it says it will do, e.g. produces effective designs)*

As discussed previously, validity is considered one of the cornerstone measures of a robust methodology [23]. Various types of validity are discussed in the literature including face validity, construct validity and predictive validity [24]. In general, validity means that a method does what it claims it will do.

Validity is related to the efficacy of a method for the problem it is intended to solve. It has been suggested that CWA should be able to demonstrate that it can handle new and novel problems and provide better outcomes than other, less resource intensive techniques [11]. A number of the attributes already discussed such as contextual validity (Attribute 9) and theoretical validity (Attribute 10) could contribute to the achievement of a valid design process.

Attribute 14: Worker / user involvement *(Definition: Involves workers / end users in the design process)*

As noted previously in relation to stakeholder involvement, ownership of the system should reside, in part, with those who will operate and use the system as these people will continue to shape the system over time [17]. User participation in design is one of the underpinning principles of the HF discipline. User-centered design has been used in combination with CWA to improve design concepts and solutions in a number of applications [e.g. 4, 33]. Participation of potential end users has also been used as a criterion to evaluate HF methods [e.g. 20].

1.1 Prioritisation of Methodological Attributes

The 14 attributes were presented to CWA practitioners via an electronic survey. Respondents were asked to rank the identified attributes for a CWA-based design approach in order of importance, with a rank of one indicating that this was the most important attribute and a rank of fourteen indicating an attribute was the least important. This was undertaken to gain feedback from the potential user group on the relative priority of the different attributes. This prioritisation process was considered necessary as it can be difficult for a single method to fulfill all attributes [29].

The rankings provided by the survey respondents revealed six key attributes required for a new CWA-based design approach (see Table 1). These principles, highlighted in italics, were that the approach facilitates creativity, is holistic, facilitates iteration, is efficient, integrates with existing system engineering processes and provides a structured approach.

Table 1. Results of ranking of the 14 proposed attributes of a new CWA-based design approach

Attribute	Average ranking	Attribute	Average ranking
1. Creative	*5.65*	*8. Structured*	*7.1*
2. Efficient	*6.5*	9. Tailorable	7.45
3. Holistic	*5.65*	10. Theoretical	8.4
4. Integrated	*6.8*	11. Traceable	9.3
5. Iterative	*6.3*	12. Usable	7.65
6. Reliable	8.05	13. Valid	8.75
7. Stakeholder involvement	9	14. Worker / user involvement	8.4

2 The CWA Design Tool

Based on a review of the literature and the survey findings a prototype CWA design process was developed. The CWA-DT was developed to align with the six more highly endorsed principles from the CWA practitioner survey. Development of the tool drew upon information from the literature on HF methods, systems engineering, and design. Input was also gathered via a workshop of CWA experts, with further discussions held to assist in evaluating options and refining the design approach.

The CWA-DT comprises guidance for analysis and design, acknowledging the interconnectivity of these processes and the artificial nature of a stand-alone design approach with no reference to the analysis. The analysis guidance assists practitioners to define the perceived problem and any known boundaries on the analysis and design process. It provides guidance for selecting the most appropriate phases and tools for exploring that problem and for moving through the analysis stages, referring to other literature and tools already available to CWA users. Key aspects of the analysis process include that it promotes connectivity and iteration between phases, involvement of subject matter experts and stakeholders, and documentation of design insights throughout the analysis process.

The design process begins with a review of the design insights and synthesis of these into a design brief. Next, the outputs from the last phase of the analysis undertaken (as not all phases will be completed for all design applications), are reviewed and a template completed identifying the high level requirements for subsequent design activities. Key aspects of the design process include use of structured documentation such as a design brief and design criteria document, promotion of iteration amongst phases of design (including changes to design documentation where required) and participation of users and other stakeholders.

Table 2 outlines how the CWA-DT aligns with the methodological attributes rated highly in the CWA practitioners' survey.

Table 2. Features of the CWA-DT related to the six highest rated methodological attributes

Attribute		Description of CWA-DT alignment
Creative	-	Incorporates techniques to promote creativity during the design process for example:
	~	Individual and group brainstorming in a workshop setting
	~	Creativity boosting exercises
	~	Room set up according to research on creativity boosting environments
	~	Selection of diverse design participants
	~	Provision of constraints within which creativity can be explored
Holistic	-	Incorporates prompts based on the holistic view provided by the CWA analysis
	-	Incorporates prompts for considering which aspects of the system should be considered (e.g. does the proposed design require a change to procedures or rules, or to the way teams coordinate, etc)
	-	Designs evaluated through the analysis models highlighting interactions (potential emergence) and potential inconsistencies between the existing and proposed system
	-	Evaluation of design concepts to identify potential unexpected system functioning from implementation
Iterative	-	Iteration encouraged throughout the analysis and design process, particularly as design concepts emerge. For example, the process encourages:
	~	Review and revision of the WDA following each later analysis phase
	~	Iteration of design concepts and solutions throughout the design phase
	-	Encourages amendments to design templates if necessary due to emerging understanding of the problem as the design process proceeds
Efficient	-	Guidance minimises time required to set up a design process for each application
	-	Guidance supports non-CWA trained participants in the design process to more quickly understand the key concepts
	-	Guidance provided for tailoring design process to meet project constraints
	-	Encourages analysts, designers and stakeholders to participate in both analysis and design changes, minimising inefficiencies involved in hand-over activities
Integrated	-	Prompts consideration of relevant design standards relating to the system of interest
	-	Analysis brief prompts consideration of the project dependencies such as concurrent system design activities
	-	Encourages participation of system designers in the analysis and design process, facilitating integration with concurrent or subsequent system design activities
Structured	-	Use of standardised templates for the analysis brief, design brief, design criteria and design concept documentation
	-	Guidance provides structure to analysis and design processes, acknowledging that users of the methodology may modify the processes to suit their particular purposes

3 Application to Road Safety Issues

While intended that the CWA-DT will be useful for design within a wide range of domains, it will be formally validated in a road safety context. This will involve applying the tool to a road safety issue and then gathering data and feedback on the extent to which it meets the highly rated attributes outlined in Table 2, as well as more traditional reliability and validity measures.

There are numerous applications within road safety for the CWA-DT including areas already explored with CWA such as intersections [6] and in-vehicle interfaces [e.g. 4, 5], as well as emerging areas of concern [34]. These emerging areas might include designing to promote safe cycling and walking and improving the design of road interfaces with public transportation including railway level crossings (grade crossings) and passenger safety at bus and light rail stops. The approach could potentially be applied to new developments at individual locations, to the design of new technologies or stand-alone countermeasures. The CWA-DT could also potentially be used more broadly to re-define standards and policies for road design, as well as training and education programs. Key to realising the potential of CWA in the road transport context is the evaluation, refinement, and communication of the CWA-DT.

4 Conclusion

While the CWA framework has strong support and evidence for its analysis function, it does not currently provide a design process and users of the framework are required to craft their own approach to design, with little direct guidance available within the existing literature. Through sharing the structured approach developed through this work, we hope to assist in the translation of CWA outputs into real world designs in areas such as road transport. It is expected that the availability of this approach will increase the frequency of CWA design applications, which will in turn lead to the realisation of safer, more efficient and effective road systems.

Acknowledgements. Gemma Read's contribution to this article was funded through an Australian Postgraduate Award (Industry) provided by an Australian Research Council Linkage Grant (ARC, LP100200387) to Monash University in partnership with the Victorian Rail Track Corporation, Transport Safety Victoria, Public Transport Victoria, Transport Accident Commission, Roads Corporation (VicRoads) and V/Line Passenger Pty Ltd. Dr Paul Salmon's contribution to this article was funded through an Australian National Health and Medical Research Council post doctoral training fellowship.

References

1. Salmon, P.M., McClure, R., Stanton, N.A.: Road transport in drift: Applying contemporary systems thinking to road safety. Safety Science 50, 1829–1838 (2012)
2. Vicente, K.J.: Cognitive Work Analysis: Toward Safe, Productive, and Healthy Computer-Based Work. Lawrence Erlbaum Associates, Mahwah (1999)

3. Militello, L.G., Dominguez, C.O., Lintern, G., Klein, G.: The role of cognitive systems engineering in the systems engineering design process. Systems Engineering 13, 261–273 (2010)
4. Mendoza, P.A., Angelelli, A., Lindgren, A.: Ecological interface design inspired human machine interface for advanced driver assistance systems. Intelligent Transport Systems, IET 5, 53–59 (2011)
5. Birrell, S.A., Young, M.S., Jenkins, D.P., Stanton, N.A.: Cognitive Work Analysis for safe and efficient driving. Theoretical Issues in Ergonomics Science (2012)
6. Cornelissen, M., Salmon, P.M., Young, K.L.: Same but different? Understanding road user behaviour at intersections using cognitive work analysis. Theoretical Issues in Ergonomics Science, 1–24 (2012)
7. Read, G.J.M., Salmon, P.M., Lenne, M.G.: From work analysis to work design: A review of cognitive work analysis design applications. In: Proceedings of the Human Factors and Ergonomics Society Annual Meeting (2012)
8. Stanton, N.A., Salmon, P.M., Walker, G.H., Baber, C., Jenkins, D.P.: Human Factors Methods: A Practical Guide for Engineering and Design. Ashgate, Surrey (2005)
9. Rasmussen, J., Pejtersen, A.M., Schmidt, K.: Taxonomy for cognitive work analysis. Risø National Laboratory (1990)
10. Hajdukiewicz, J.R., Burns, C.M.: Strategies for Bridging the Gap between Analysis and Design for Ecological Interface Design. In: Proceedings of the Human Factors and Ergonomics Society Annual Meeting, vol. 48, pp. 479–483 (2004)
11. Sanderson, P.M.: Cognitive Work Analysis. In: Carroll, J. (ed.) HCI Models, Theories, and Frameworks: Toward an Interdisciplinary Science, Morgan-Kaufmann, New York (2003)
12. Vicente, K.J.: Ecological interface design: Process and challenges. Human Factors 44, 62–78 (2002)
13. Jamieson, G.A.: Bridging the Gap Between Cognitive Work Analysis and Ecological Interface Design. In: Proceedings of the Human Factors and Ergonomics Society Annual Meeting, vol. 47, pp. 273–277 (2003)
14. Rehak, L.A., Lamoureux, T.M., Bos, J.C.: Communication, coordination, and integration of Cognitive Work Analysis outputs. In: Proceedings of the Human Factors and Ergonomics Society Annual Meeting, vol. 50, pp. 515–519 (2006)
15. Gualtieri, J.W., Szymczak, S., Elm, W.C.: Cognitive System Engineering - Based Design: Alchemy or Engineering. In: Proceedings of the Human Factors and Ergonomics Society Annual Meeting, vol. 49, pp. 254–258 (2005)
16. Potter, S.S., Roth, E.M., Woods, D.D., Elm, W.C.: A framework for integrating cognitive task analysis into the system development framework. In: Proceedings of the 42nd Human Factors and Ergonomics Society Annual Meeting, vol. 1, pp. 395–399. HFES, Santa Monica (1998)
17. Clegg, C.W.: Sociotechnical principles for system design. Applied Ergonomics 31, 463–477 (2000)
18. Gonzalez Castro, L.N., Pritchett, A.R., Bruneau, D.P.J., Johnson, E.N.: Applying coherent design to uninhabited aerial vehicle operations and control stations. In: Proceedings of the Human Factors and Ergonomics Society Annual Meeting, vol. 51, pp. 181–185 (2007)
19. Bisantz, A.M., Roth, E., Brickman, B., Gosbee, L.L., Hettinger, L., McKinney, J.: Integrating cognitive analyses in a large-scale system design process. International Journal of Computer-Human Studies 58, 177–206 (2003)
20. Waterson, P.E., Older Gray, M.T., Clegg, C.W.: A sociotechnical method for designing work systems. Human Factors 44, 376–391 (2002)

21. Older, M.T., Waterson, P.E., Clegg, C.W.: A critical assessment of task allocation methods and their applicability. Ergonomics 40, 151–171 (1997)
22. Stanton, N.A., Stevenage, S.V.: Learning to predict human error: issues of acceptability, reliability and validity. Ergonomics 41, 1737–1756 (1998)
23. Stanton, N.A., Young, M.S.: What price ergonomics? Nature 399, 197–198 (1999)
24. Baber, C., Stanton, N.A.: Task analysis for error identification: Theory, method and validation. Theoretical Issues in Ergonomics Science 3, 212–227 (2002)
25. Baysari, M.T., Caponecchia, C., McIntosh, A.S.: A reliability and usability study of TRACEr-RAV: The technique for the retrospective analysis of cognitive errors - For rail, Australian version. Applied Ergonomics 42, 852–859 (2011)
26. Gawron, V.J.: Handbook of human performance measures. Lawrence Erlbaum Associates, Mahwah (2000)
27. Sanderson, P., Eggleston, R., Skilton, W., Cameron, S.: Work Domain Analysis workbench: Supporting Cognitive Work Analysis as a systematic practice. In: Proceedings of the Human Factors and Ergonomics Society Annual Meeting, vol. 43, pp. 323–327 (1999)
28. Baxter, G., Sommerville, I.: Socio-technical systems: From design methods to systems engineering. Interacting with Computers 23, 4–17 (2011)
29. Shorrock, S., Kirwan, B.: Development and application of a human error identification tool for air traffic control. Applied Ergonomics 33, 319–336 (2002)
30. Elm, W., Gualtieri, J., Tittle, J., Potter, S.S., McKenna, B.: Pragmatic use of cognitive work analysis in system design- Extending current thinking by adapting the mapping principle. In: Bisantz, A.M., Burns, C.M. (eds.) Applications of Cognitive Work Analysis. CRC Press (2008)
31. Stanton, N.A., McIlroy, R.C.: Designing mission communication planning: the role of Rich Pictures and Cognitive Work Analysis. Theoretical Issues in Ergonomics Science 13, 146–168 (2012)
32. Kilgore, R., St-Cyr, O., Jamieson, G.A.: From Work Domains to Worker Competencies: A Five-Phase CWA. In: Bisantz, A.M., Burns, C.M. (eds.) Applications of Cognitive Work Analysis, pp. 15–48. CRC Press (2008)
33. McIlroy, R.C., Stanton, N.A.: Specifying the requirements for requirements specification: the case for Work Domain and Worker Competencies Analyses. Theoretical Issues in Ergonomics Science 13, 450–471 (2012)
34. Salmon, P., Stephan, K., Lenné, M., Regan, M.: Cognitive Work Analysis and Road Safety: Potential Applications in Road Transport. In: Australasian Road Safety Research Policing Education Conference (2005)