Hon D Chester
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Parliament House
Canberra ACT 2600
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Inquiry into the National Road Safety Strategy 2011-2020

Dear Minister,

I was very pleased to your announcement to inquire into the national road safety strategy. Unfortunately I haven't been in a position to comment properly until now.

There are still many things we can do to reduce road trauma in Australia, but these are mostly at the operational level. Unfortunately, the evidence around the world is that the successes of the past aren't continuing, so it is very likely that road safety will deteriorate in future, as we're experiencing in Australia. I'm sure you are well aware that road safety is a complex issue, so more systematic and structural responses are required.

As an example, you have highlighted the issue of public acceptance of road safety. This is evidence of a 'safety culture' which has been a foundation concept in hazardous industries, aviation and railways for many years, but is almost entirely absent in road safety management.

In general, road safety is doing some things better than in the past, but still within the limited framework of engineering, enforcement and education applied to drivers, vehicles and roads - a framework that is at least 80 years old. This is the approach that the previous Senate Inquiry into *Aspects of road safety in Australia* took, that produced predicable minor recommendations and limited results.

There has also been some commentary that perhaps the simple solutions of the past aren't sufficient to achieve the future outcomes we intend. In other words "We cannot solve our problems with the same thinking we used when we created them." (attributed to Einstein, probably wrongly). I'm sure we can do some things better, but the results will be limited; we need to do road safety *differently*.

For the past few years I've been relating my 30+ years of transport experience to the difficult issue of road safety strategies, in a PhD. The result is a comprehensive framework for future road safety strategies that is thoroughly based on systems theory for the first time. The examiners were complementary regarding the innovative and comprehensive result, based on the depth of the foundation material and appreciation of the complexity of issues. One examiner was Claes Tingvall, a world leader in road safety strategies for 20 years.

My work was born out of several observations including:

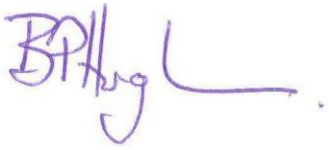
- 'Everyone' talks about ‘systems’, but few have much idea what a system is, so systems concepts are poorly applied, and their full value isn't achieved,
- The Safe Systems framework is a general philosophy rather than a practical framework that engineers and others can easily relate to and apply thoroughly,
- A lot of actions claim to apply Safe Systems, but don’t incorporate systems concepts,
- Safe Systems doesn’t recognise the wider transport & land use, economic or social contexts, that we know are important when considering transport elsewhere,
- We seem to be reaching the limits of road safety improvement within our current thinking, so new approaches are required,
- We need approaches that look forward to a different future, rather than rely on historical information and previous approaches that have limitations.

I've attached an introduction and summary for your consideration. The framework covers objectives, principles, components, countermeasures, participants, processes and interrelationships. I'll send you the full thesis when it's published in the near few weeks. The framework offers opportunities to create new countermeasures, guide research and to identify weaknesses in existing strategies.

Thoroughly and diligently adopting systems approaches in road safety has the potential to significantly improve outcomes, as others have found in other fields of safety management. In particular, applying systems approaches to road safety strategy, policy, planning and practice offers the opportunity to efficiently and effectively achieve the next reductions in road trauma that are necessary, but have become increasingly elusive recently. We certainly need much more holistic, efficient and effective ways of operating than our traditional practice.

I have provided the same information to Prof. Woolley and Dr Crozier and I'll be pleased to discuss with you or the Inquiry team further, if I can help at any time.

Kind Regards,



Brett Hughes

Applying *Systems Approaches* to Road Safety

We know the world is dramatically changing. While change has always occurred, it has continued to accelerate over many years. Our economic, social, environmental and political landscape[1] is becoming more and more volatile, uncertain, complex and ambiguous[2]. Therefore:

We cannot solve the problems using the same kind of thinking we use when we created them.[3]

The present world is already different from the past, on which we've based our road safety policy analysis, strategies and planning. But the future will be even more different. We tend to look at problems from a historical perspective favouring what we know and can see from the past, and how we have previously responded to challenges. Unfortunately, this approach stifles innovation and doesn't work in complex systems or when circumstances change unexpectedly.

In short: *theories, models, philosophies, and methods stemming from an earlier era of scientific thought and developed for simpler, mostly physical systems are largely inapplicable for a mind, a society, an economy, or an ecosystem.*

Unfortunately, by far the usual practice is for people to apply the simplest possible interpretations to complex situations.[4]

or simply:

What got us here won't get us there.[5]

In the past, governments and their agencies could act successfully in glorious isolation. Now, nearly everything is connected to everything else. But agencies still operate, and policy tools are applied, independently. But it doesn't work well anymore, because doing so loses synergies and creates undesirable consequences. Additionally, we're quite good at **tactical** and **operational** change, not so good at **strategic** change and awful at **systemic** or **structural** change. So, **we need new integrated and holistic ways of tackling problems and delivering solutions.**

Road safety strategies worldwide are characterised by historical perspectives and analysis of the situation. They universally rely on engineering, enforcement and engineering countermeasures applied to drivers, vehicles and roads. However, this reductionist and simplistic approach is nearly a hundred years old. It does not recognise other countermeasures, factors or influences affecting road safety outcomes. So, our traditional road safety strategies approaches cannot respond to future challenges such as social, technological, business and political changes that are continually occurring and accelerating. The current Safe Systems approach[6] represents an initial example of applying some aspects of systems thinking, but there is much more than can be done based on systems theory. Current road safety strategies do not thoroughly incorporate contemporary safety management techniques that have been successfully applied in other high risk operations such as aviation, or hazardous industries. In order for road safety to continue to improve, ***systems approaches*** ***offer a great opportunity for the next 'step change' to improve strategy, policy, planning and practice in road safety.***

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[1] PESTLE – e.gpestleanalysis.com/what-is-pest-analysis -

[2] VUCA – e.g. Bennett, N., & Lemoine, G.J. (2014). What VUCA really means for you. *Harvard Business Review*, - and Solomon, L.K. & Ertel, C. (2014). Leadership in a VUCA world: Design strategic conversations to accelerate - change. *Leadership Excellence Essentials.* -

[3] attributed, probably wrongly, to Einstein -

[4] De Greene, K. (Ed.). (1993). *A systems-based approach to policymaking*. Boston, MA: Kluwer Academic. -

[5] Goldsmith, M. (2007). *What got you here won't get you there: How successful people become even more - successful*. New York, NY: Hyperion. -

[6] ATC (2011). *National Road Safety Strategy 2011-2020.* Canberra, Australia: Australian Transport Council. -

Systems Approaches

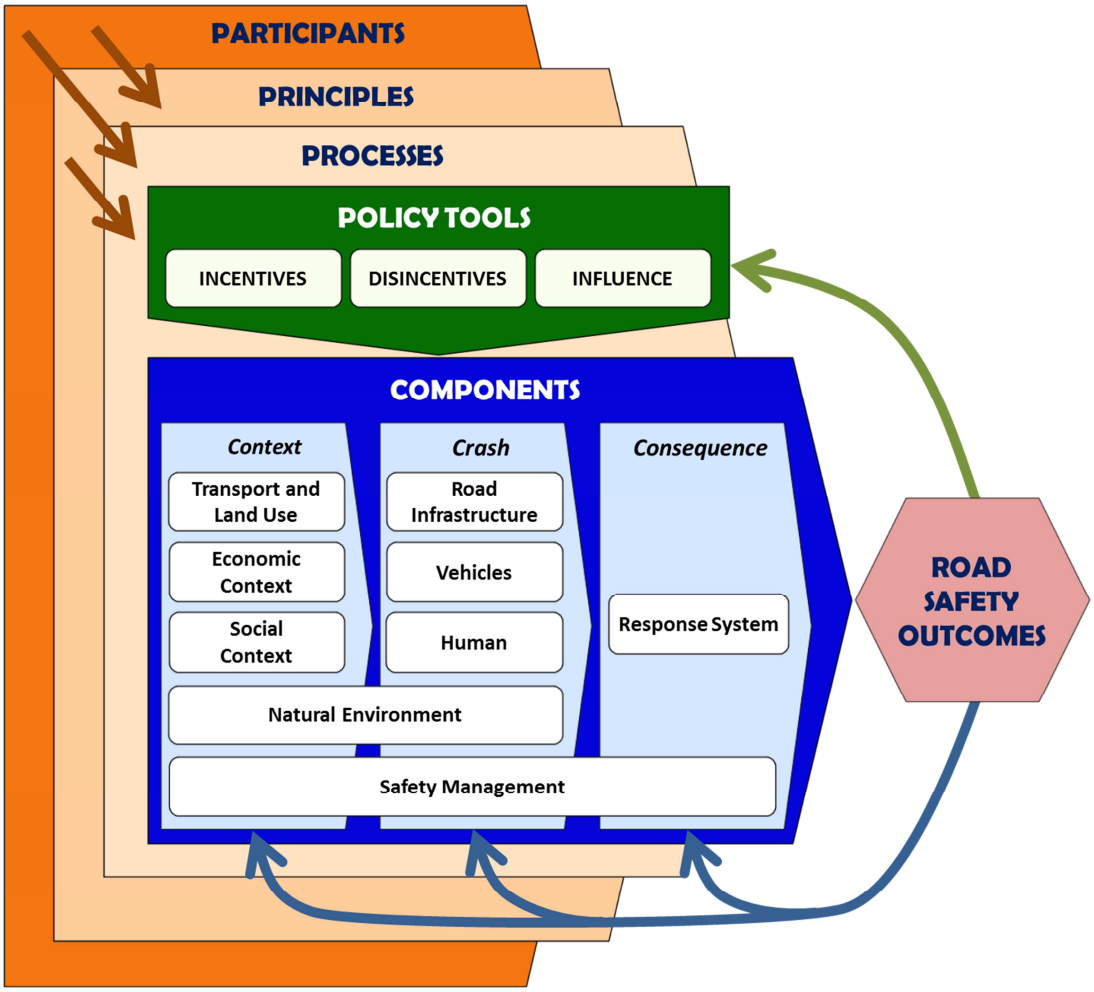
Systems approaches developed from a thorough theoretical and practical basis, justified research and evidence from successful practice to address complex systems, circumstances and issues. A socio-technical system can be defined as:

> *an interacting combination, at any level of complexity, of people, materials, tools, machines, software, facilities, and procedures designed to work together for some common purpose.*[7]

This ***Systems Approach*** applied to road safety is summarised and shown diagrammatically below[8].

A fundamental characteristic of systems is that the outcome being achieved is greater than the sum of the individual Participants, Policy Tools or Components operating in isolation. ***Systems approaches*** maximise the positive and complementary interactions, and minimise the negative or contradictory interactions. Applications of systems theory requires:

> *understanding the system as a whole and the interaction between its elements, and identifying where there is potential for intervention*[9]*.*



[7] Chapanis, A. (1996). *Human factors in system engineering*. New York, NY: John Wiley and Sons. -

[8] Hughes, B., (2017) *A Comprehensive Framework for Future Road Safety Strategies*,. PhD Thesis, Curtin - University, under examination. -

[9] Peden et al. (2004), *World health report on road traffic injury prevention*. Geneva, Switzerland: World Health - Organization. -

A Systems Approach for Road Safety Strategies

The essential constructs of the systems approach for road safety strategies include:

- ***Purpose*** – a clear statement of the objective, which can also relate to its measurement, estimation, forecasting or setting of a target (realistic, aspirational, etc.).
- ***Participants*** – all individuals and groups who can affect the system.
- ***Principles*** – a broad way of behaving that is expected to be followed, or guidance for action
- ***Components*** – including, for transport, roads/rail/intermodal terminals/ ports/ airports, vehicles/rolling stock, users/operators/drivers, information systems, policies, etc.
- ***Policy Tools*** – the actions that Participants apply to the Components to achieve the Purpose (outcomes).
- ***Relationships*** – interactions between Components, Participants and Policy Tools.
- ***Processes*** – a **toolkit** of techniques for management, strategic planning, research, assessment, policy/program/project development, implementation, delivery, evaluation, monitoring and reporting, etc.

Unfortunately, especially in a world of complexity, for every difficult problem:

There is always an easy solution to every human problem - neat, plausible, and wrong.[10]

There is a risk of overly simplifying problems and their solutions. Unless a comprehensive ***systems approach*** is taken, there is a risk that the best possible outcomes will not be achieved most cost efficiently.

A further complication of complex systems is that they have multiple purposes, which is especially true for Government. ***Systems approaches*** have been identified as relevant for Governments:

public services should be understood as complex adaptive systems, and not according to the mechanistic models that have traditionally dominated government thinking.

So Governments should:

focus on the skills needed to deal with social complexity, in order to achieve high levels of systems thinking and a basic understanding of behavioural change.[11]

Systems approaches have strong theoretical[12], research and practical foundations. With a diverse history in biology and electronics, it has been successfully applied in several relevant fields, such as safety, reliability engineering and information technology, but not in government policy, planning and service delivery. So, if it was applied to these activities we might say:

Participants use processes to apply policy tools to affect contributing components in order to achieve outcomes (economic, social and environmental improvement). These all occur in complex interdependent relationships or influences of change within the system.

[10] Attributed to H.L. Mencken (1927), https://en.wikiquote.org/wiki/H._L._Mencken

[11] APSC (2007).*Tackling wicked problems: A public policy perspective*. Canberra, Australia: Australian Public Service Commission (APSC), Australian Government.

[12] e.g. Leveson, N.G. (2011a). *Engineering a safer world: Systems thinking applied to safety*. Cambridge, MA: Massachusetts Institute of Technology, and Von Bertalanffy, L. (1968). *General system theory: Foundations, development, applications*. Harmondsworth, UK: Braziller, Inc.

Underpinning the framework is considerably more detail[13] that describes a multitude of potentially relevant Components, Policy Tools, Participants and Processes that should at least be considered in road safety, strategy, policy, planning and practice.

Many existing and emerging problems are more intractable (perhaps 'wicked'[9]) than ever before. So, simple solutions often don't work well now – and they certainly won't be effective in future. In other cases, the simple solutions have been successfully applied, but more complex and difficult solutions are required. In other words, we've nearly shot all the 'silver bullets', so we need to create and apply new approaches. Applying ***systems approaches*** can improve understanding and consideration of the whole subject, providing a deeper knowledge on how dynamic, complex, interconnected behaviour contributes to road safety outcomes.[14]

Purpose

If outcomes are the beneficial or adverse consequences of a system when it is functioning, or something of value that is produced or as a result, then a system's Purpose is simply the desirable outcomes that are intended to be achieved. In systems, every Component makes a contribution to achieving the outcomes, and the outcomes of the system are greater than the individual parts operating independently. Therefore, failure or suboptimal performance of any individual Component reduces the best Purpose of the whole system being achieved.

While the Purpose of road safety is straightforward in principle (to reduce road trauma), the practical description becomes much more problematic[15]. Road trauma can be measured in terms of people killed and seriously injured (KSI's, economic costs or simply crashes according to different levels of severity). All of these can be measured in absolute numbers, but ratios (e.g. number per capita) can be much more useful for comparisons between jurisdictions and takes account of at least one macro-economic factor (population change).

As for other uses in organisations and operations, performance measures are useful for monitoring, assessing progress and managing peoples, resources and processes. Modern contemporary road safety strategies describe 'targets', such as expected reductions over time, or 'zero harm' as a longer term aspirational objective. ***Systems approaches*** aim to apply targets to increase the efficiency and effectiveness of road safety policies, programmes and projects to improve road safety performance. It is wrong to assume that "*if you can't measure it, you can't manage it*" (a costly myth according to Deming[16]), so quantitative performance assessment is valuable, but it is not sufficient and should be in conjunction with qualitative performance assessment.

Traditional analytical techniques such as quantitative modelling can be useful for measuring performance as described. However, analysis to determine system performance or its management is more difficult. New performance assessment techniques are required to take account of the systems nature of road safety, particularly Relationships between Components, Participants or Policy Tools. Such performance measurement may also require new and different analytical techniques, such as system dynamics, to more usefully inform the management of road safety systems.

[13] The nine Components in the systems framework for road safety contains 75 subcomponents. -

[14] Underwood, P. & Waterson, P. (2013). Systemic accident analysis: Examining the gap between research and practice. *Accident Analysis and Prevention, 55*, 154-164. -

[15] Hughes, B.P., Hopkins, S. (2011). *Outcomes-based national road safety performance measures*. Proceedings of Australasian College of Road Safety Conference[3], Melbourne, Australia. -

[16] Deming, W.E. (1994) p35. *The New Economics*. Cambridge, MA: Massachusetts Institute of Technology. -

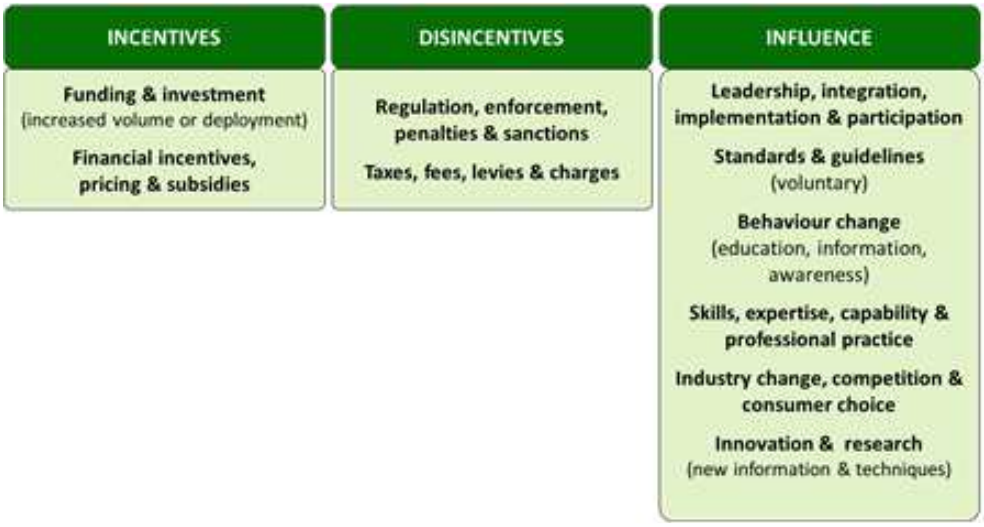
Components

Transport planners, policy makers and others involved in managing transport systems readily relate to vehicles, infrastructure, drivers and other users as the key tangible Components of the system. In systems theory, a Component is any subordinate part of the system that is essential to contributing to the outcome or Purpose. Traditionally in road safety, Components are limited to drivers, vehicles and roads (sometimes road infrastructure or the road environment). However, it has been demonstrated over a long period of time that other Components are equally significant in achieving outcomes, including some that are less tangible and not necessarily physical. These broader Components include the Transport and Land Use Context, Economic Context, Social Context, Natural Environment, Vehicles, Human, Infrastructure, Response System and Transport Management. Both the social system and economic factors have been identified as contributing factors earlier[17], but are not commonly included in road safety research, analysis or strategies. Each of these Component groups have considerable detail, as illustrated in Attachment 1, which describes the subcomponents which apply to road safety.

Thoroughly employing ***systems approaches*** to achieving road safety objectives ensures that any and all of the Components and subcomponents that can be applied to improve outcomes are properly managed.

Policy Tools

While there is considerable literature on processes for policy development and analysis of policies, there is little information on the variety of Policy Tools that could be applied. This can lead to narrow perspectives if policy developers do not have appreciation of a wide range of instruments that governments can apply in order to achieve outcomes. They simply don't know all the 'tools' that are available in the 'toolbox'. The following arrangement for the complete range of potential Policy Tools available to governments that can be applied to road safety, was developed based on theoretical background[18], research and practice[19]. A more comprehensive list is provided in Attachment 1.



[17] e.g. Haddon, W. (1980). Options for the prevention of motor vehicle crash injury. *Israel Journal of Medical Sciences, 16*(1), 45-65. -

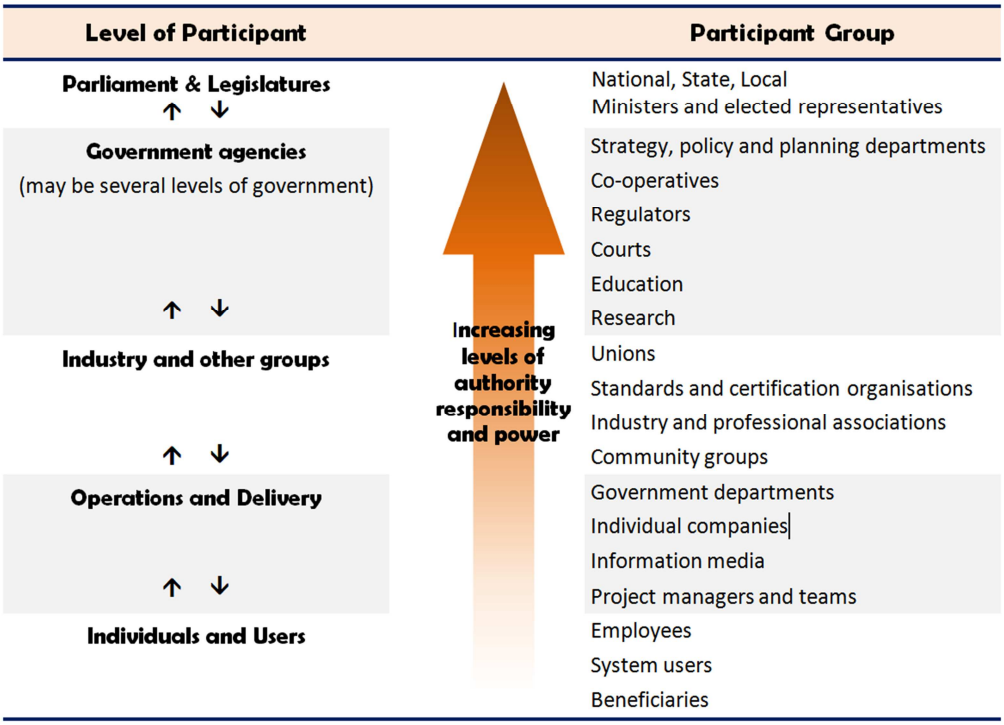
[18] e.g. Vedung, E. (2003). Policy instruments: Typologies and theories. In: Bemelmans-Videc, M-L., Rist, R.C., &Vedung, E. (Eds), Carrots, sticks and sermons. New Brunswick, NJ: Transaction Publishers. -

[19] Hughes, B., (2017) *A Comprehensive Framework for Future Road Safety Strategies*,. PhD Thesis, Curtin University, under examination. -

Participants

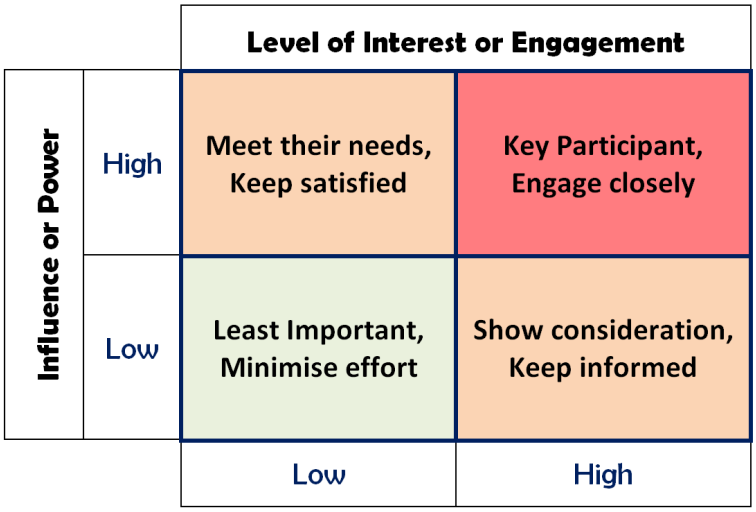
A Participant[20] is any individual or entity that has the capability to affect outcomes, including government, agency, association, company or individual person. Sometimes Participants are categorised as customers, users or stakeholders. Participants vary according to levels *authority*, *responsibility* and *power*, as summarised in the following diagram.

Systems approaches recognise the importance of the roles and impacts of all relevant Participants, so that their contribution and benefits can be maximised and their negative effects and disadvantages are minimised. Participants can complement the Purpose or detract with it, being either conflicting or competitive. Other Participants who are passive may be activated to become either positive or negative depending on the motivation.



The Mendelow Matrix[21] is a common way of characterising Participants in business, as shown in the following diagram.

[20] In systems theory, literature and practice, 'participants' are normally called 'actors'.
[21] Mendelow, A. (1991) 'Stakeholder Mapping', Proceedings of the 2nd International Conference on Information Systems, Cambridge, MA



Relationships

A fundamentally important characteristic of systems is that the outcome being achieved is greater than the sum of the individual Participants, Policy Tools or Components operating in isolation. The object of applying ***systems approaches*** is to maximise the positive and complementary interactions and minimise the negative or contradictory interactions.

The Relationships between Participants, Policy Tools or Components are integral to the success of systems. Positive relationships (interdependent and complementary) are fundamental to a system achieving its Purpose. Negative relationships (independent or conflicting) may exist, but are inconsistent with a system achieving its Purpose. Relationships are recognised as an essential element of the systems, but are often complex to describe. ***Systems approaches*** recognise and maximises the positive relationships, but may not always recognise negative relationships that also require management. This can be especially important in road safety where 'push back' can occur through community responses or individual's psychological responses.

Principles

Principles for safety management are a broad way of behaving that are expected to be followed or guidance for action, that reflect, or are reflected in, values, beliefs, norms, and other actions in an organisation[22], and are acknowledged as being important to guide decision making and actions.

Principles that Participants use in developing road safety strategies are diverse, however leading road safety strategies include principles similar to those described by OECD/ITF[23]:

- *People make mistakes that can lead to road crashes.*
- *The human body has a limited physical ability to tolerate crash forces before harm occurs.*
- *A shared responsibility exists amongst those who design, build, manage and use roads and vehicles and provide post-crash care to prevent crashes resulting in serious injury or death.*
- *All parts of the system must be strengthened to multiply their effects; and if one part fails, road users are still protected.*

[22] Hine, D.W., Lewko, J., & Blanco, J. (1999). Alignment to workplace safety principles: An application to mining. - *Journal of Safety Research, 30*(3), 173-185. -

[23] OECD/ITF (2016, p26). *Zero road deaths and serious injuries: Leading a paradigm shift to a safe system*. Paris: - International Transport Forum (ITF), OECD. -

Processes

Processes are complementary activities to achieve an outcome. Since time occurs in one direction, processes often occur linearly and sequentially. However, different activities in Processes can occur simultaneously. Processes occur in many situations in order to achieve road safety outcomes including management, research, policy deployment and implementation[24]. Processes relevant to road safety include strategic planning, risk analysis, behaviour change, culture change, project management, engineering design, performance monitoring and evaluation, and so on.

It is important to appropriately apply any and all relevant processes in order to efficiently and effectively achieve the system's Purpose. However, the management of Participants' Relationships is particularly important. In complex systems and/or when dealing with complex problems that have multiple Components, Participants and Relationships, collaboration is essential. While getting several Participants to work together to achieve an outcome sounds obviously necessary, it is often not easy and can require considerable skill and effort. However, not doing do risks the outcomes not being achieved. People and organisations have individual information, perceptions, beliefs, values, and culture. These can lead to many attitudes, such as bias, defence or enthusiasm resulting in either positive or negative behaviours that affect the system's Purpose, or otherwise passivity. There is a rich raft of literature, describing many techniques about communications, cooperation, collaboration and behaviour change processes for individuals and organisations. Successfully applying ***systems approaches*** requires thorough application of Processes to manage Participants' relationships while maintaining a clear focus on the system's Purpose.

Conclusions

Thoroughly applying ***systems approaches*** offers the potential to significantly improve contemporary, intractable problems that can't be solved by simple solutions. Doing so can overcome barriers and provide multifaceted and multisectoral solutions via collaborative partnerships, built on synergies focussed on achieving holistic and integrated outcomes.

In particular, thoroughly applying ***systems approaches*** offers the opportunity to efficiently and effectively achieve the next improvements to road safety that are necessary, but have become increasingly elusive recently. Based on this framework, some examples of ***systems approaches*** in road safety are described in Attachment 3.

It's obviously not easy, but thoroughly and diligently applying ***systems approaches*** to road safety strategy, policy, planning and practice has the potential to significantly improve outcomes, as others have found in other fields of safety management. We certainly need much more holistic, efficient and effective ways of operating than our traditional practice.

The framework can potentially be used in many different ways, yet to be explored. For further information, questions or comments, please contact Brett Hughes.

[24] Hughes, B., (2017) *A Comprehensive Framework for Future Road Safety Strategies*,. PhD Thesis, Curtin University, under examination.

Attachment 1 - Details of Components

COMPONENT	SUBCOMPONENT DESCRIPTION
Transport and Land Use Context	Transport alternatives, other modes, company operations Spatial Arrangement, co-location Accessibility – remoteness, location, service levels Transport integration
Economic Context	Economics, finance, funding Population, employment structure Environment, energy, climate change Legal – regulation, liability, privacy, insurance, courts, corrections
Social Context	Politics and government Law – role and response Social norms, nurture, background, traditions, rituals Ethnic practices Spiritual beliefs Literacy, intellect, education Employment - practices, demands, restrictions Activities, travel purposes
Natural Environment	Daylight, dawn, dusk, night, sun Weather and atmospheric conditions - rain, fog, snow, smoke, wind, temperature Adjacent environment - topography, trees, grass, water Wildlife
Road Infrastructure	Surface - friction, colour, smoothness, cracks, edges, shoulders, unsealed, pothole, concrete asphalt, seal, manhole, drain, repair, cycle facility, drainage, grit, spills, footpaths - wet, dry, snow, ice, other Geometry - alignment geometry, curve, crest, dip, gradient, level, lanes, crossfall, physical dimensions, dual carriageway, passing lane, shoulder, median Signs, regulatory, advisory, pavement marking, signal, manned, speed limits, active/passive, reflectors, colour, illumination, reflectivity, access control, street design, bus lanes, roadworks Lighting - roadway, features and adjacent Obstacles - pylons, gutter, kerb, culvert, bridge, pole, other street furniture, safety barrier, tunnel, building, overpass, tree, bus facilities Intersection type - intersection, junction, roundabout, grade separation, merge, railway crossing, crosswalk or crossing point, angled, pedestrian crossing, island Road type - Freeway, highway, city street, residential, rural, bridge, tunnel Miscellaneous - driveway, midblock, parked cars, stopped buses, lighting, glare, road debris, previous collision, landslides, work zones, tram / light rail Traffic volume, type, interaction Safety devices - guardrail, barrier, rest stop, fence, service area, route guidance, landslide protection Maintenance

COMPONENT	SUBCOMPONENT DESCRIPTION
Human	Participants - Driver, passenger, witness, acquaintance, occupant, road workers Age and sex Impairment - alcohol, drugs, medicines, carbon monoxide, drowsiness, sleep, disablement (seizures, pain, blackouts, disabilities), fatigue Driving Process* - strategy, tactics, perception, alertness, reaction, attention, distraction, error correction, response to incidents and conditions Abilities - physical, vision, hearing, mental state, injury, illness, disability, health Capability - natural, learned, skill, intelligence, education, experience Attitude, motivation, demeanour, emotion, psychological state, behaviour Time (day, week, month, season), type of trip Capability - licence, restrictions Helmets, clothing and other protection Clothing - visibility, protection, interference
Vehicles	Type- car, truck, trailer, motorcycle, bicycle, bus, farm machinery, other Design*- standards, maintenance, damage, modifications, inspections Wheels and tyres* - size, type, tread, pressure, condition, chains Brakes* Controls* - steering, pedals, levers, switches Body type* and mass Seat belts, child restraints and other protection Lights* - external, internal, type, performance, colour, reflectors Cargo - type, characteristics, mass, strength, shape, hazardous Structure* - frame, doors, panels, safety features, crashworthiness, fittings, mirrors, mountings, flammability Suspension Engine, transmission, fuel type Instruments Electrical components and circuits Colour Glass - colour, type Movement - speed, direction, angle, acceleration, coasting, deceleration, turning, overtaking, reversing, force, vibration Liquids and fluids Type of impact - speed, angle, physical dimensions Active safety and other technology - Antilock brakes, electronic stability control, adaptive cruise control, speed control, etc. *Note : * Generally applicable to motor vehicles, but may be applied to others*
Crash Response	Emergency & rescue services Crash reporting and incident management Heath treatment – first aid, emergency treatment, injury treatment, Rehabilitation, permanent care & adaptation
Safety Management	Risk Management - identification, assessment, countermeasures, revision Information - research, data, investigations, benchmarking Capability - skills, knowledge, experience, of all participants Capacity - financial, human, system, technology Systems - processes, structures, procedures, standards Integration - collaboration, coherence, synergy, co-ordination, optimisation Implementation – policy, planning, design, installation, maintenance, monitoring, revision Communication – content, contact, medium Culture - attitudes, beliefs, values, commitment

Attachment 2 - Details of Policy Tools

POLICY TOOL	DESCRIPTION	EXAMPLE OF DETAILS
INCENTIVES		
Funding & investment	Application of finances to increase the amount of facilities, services, assets, product or level of deployment	Purchasing of vehicles, tools, systems and equipment, infrastructure investment, services delivery, deployment of staff, engineering production, maintenance and product delivery
Financial incentives, pricing & subsidies	Voluntary monetary or in-kind payments, costs and rewards to encourage desired behaviour or practice Financial transfers and cross subsidies	Inducements or rewards for good behavers, or disincentives or penalties for poor behavers Taxes and charges that provide road safety benefits (e.g. alcohol excise) Discounts for insurance and registration, payments to service providers
DISINCENTIVES		
Regulation, enforcement, penalties & sanctions	Activities to develop and apply a legislative authority	Legislation, rules, orders, enforcement, penalties, sanctions, mandatory application of standards
Taxes, fees, levies & charges	Financial charges applied to discourage undesirable behaviour or practice	Payments for costs incurred, fees to encourage behaviour change, levies to fund policy tools
INFLUENCE		
Leadership, integration, implementation & participation	Desktop, office, personal and relational activities regarding the planning and delivery of policies, programs and projects to optimise safety outcomes – excludes actual delivery of a policy	Leadership – advocacy, campaigning, general background information, strategic planning, development, assessment, selection of effective and efficient policies, programs and projects, outcomes monitoring Integration – coordination, optimisation, information exchange, output management Implementation – planning, programming, timing, impact assessment Participation – dialogue with stakeholders, negotiation, agreements, engagement
Behaviour change	Activities that encourage people to behave more safely – separate from, but may be linked to incentives, pricing, subsidies and regulatory mechanisms	Education, information, awareness, rational encouragement, individualised information, mass campaigns
Skills, expertise, capability & professional practice	Development of personal capacity, competency and fitness to undertake a task Development of professional skills and practice	Training, experience, knowledge, skilling Medical, physical and intellectual fitness for duty
Standards & guidelines	Voluntary application of written authoritative agreements or references with respect to design and practice	Formal and informal standards and guidelines for good practice – may be recommended, desirable or minimum
Industry change, competition & consumer choice	Application of strategic advantage to provide a market advantage – influences in markets that result in a desired outcome	Performance enhancement, lower costs, improved service, provision of market information (price, performance or quantity)
Innovation & research	Investigation and development of new information with respect to behaviour, practice, product or operations and initial deployment to prove and refine applicability	Basic and applied research, pilots, trials, evaluations, new general and specific information, continuous improvement

Attachment 3 – Examples of Applying Systems Approaches in Road Safety

Drugs and society

Salmon et al. (2017)[25] describe the application of systems approaches to investigate the emerging, but very complex problem of driving under the influence of either illicit or prescription drugs. Their example illustrates several system characteristics including appreciation of broad societal factors, application of multiple policy tools, complex feed-forward and feedback relationships, and more sophisticated analytical processes. These all need to be considered and appropriately included in order to inform the development, selection and prioritisation of policy tools operating together. In this example Salmon et al. describe that the wider context of social influences can result in greater adverse changes to road safety than the amount of improvement resulting from the road safety countermeasures. In this case, road safety effort increases, but road safety continues to degrade. The framework can contribute to such assessments by guiding the researcher regarding participants, policy tools and components that are involved in the particular subsystem that are being investigated, in the same way that the researchers apply in this example.

Speed zoning

While speed is acknowledged as a key issue in road safety, it would be simplistic to presume that simply installing new speed signs with lower limits would achieve the desired purpose. Firstly, there may be different types of users; parents driving to the school, truck drivers from a transport depot around the corner or delivery riders on motorcycles from the fast food outlets. Direct engagement with these users via modern targeted behaviour change programs can contribute to safety improvement. Does the analysis suggest that the problem changes by time of day, such as at night time, or school hours? Can the road environment be changed to demonstrate to drivers what appropriate speed is, by making an attractive, active slow speed environment (not just by 'hard' traffic calming?). Finally, what role can enforcement play? I say finally, because enforcement is often short lived, inefficient, costly and resented by drivers. So, employing more effective measures in collaboration with participants can lead to more sustainable outcomes at lower cost, leaving enforcement as a last resort, not a first ineffective and inefficient response.

Safety culture

Other hazardous industries, including aviation and railways, have embraced 'safety culture' as a core concept in improving safety. Safety culture; the underlying nature of an organisation's approach to safety, is a mature safety management concept with proven results. However, the concept is almost completely absent in road safety. Impatience, not using indicators, not keeping left, tailgating, roadworkers speeding through roadworks, etc. are all common indicators of poor attitudes, or road safety culture. The safety culture approach aims to change people's understanding and rationale for their actions, rather than enforce compliance with rules and regulations. The unwillingness of elected representatives, managers or decision making to prioritise road safety is representative of poor corporate safety culture. Applying a systems approach would describe participants' relationships with each other and the related components, to inform which of them and their behaviours are most significant and therefore warrant the most attention in changing. Describing the attitude and beliefs that drive the behaviours of these participants would then lead to prioritising the policy tools to employ to change behaviour that would best improve road safety[26].

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