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All responsibility, no care: a systems analysis case study of beach driving stakeholders in Australia

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Abstract

Since 2009 there have been more than 100 people injured and 4 killed in incidents involving four wheel drive vehicles on world heritage listed Fraser Island, off the southern Queensland coast, Australia. As a gazetted road any person with a regular on-road or international driving license is permitted to drive on the beach at up to 80km / hour. However, the beach driving environment is one of rapid change, unstable surfaces, pedestrian priority, distraction and limited signage nor instruction. Given the beach context, it is apparent that the beach driving ‘system’ is different to the standard road system'; however, this is yet to be explored both in regard to the contributory factors involved in road crashes and to the responsibilities for beach driving safety. The study presented in this paper is a response to this, attempting to identify the differences and the resulting implications for crash prevention. This paper uses the sociotechnical systems approach of AcciMap to explore and describe the range of governance structures and the large variety of actors associated with beach driving on Fraser Island. The resultant ActorMap is then examined in consideration of the multiple levels of causality in the context of the beach as a fatal roadway environment. The results allow for a greater understanding of the vertical integration between the array of decision-makers and the accidents. As well as showing clearly that beach crashes represent a significantly different problem space to road crashes, this paper identifies a number of significant failures in the management and regulation of beach driving on Fraser Island, and makes recommendations for change. In closing this paper articulates a research agenda designed to enhance our understanding of the cultural, economic, and social implications of beach and off-road driving to improve safety and stakeholder coordination.

Keywords: Systems analysis; Beach driving; Off road accidents; Accimap
1. Introduction

Fraser Island or K’gari (paradise) in the language of the local aboriginal people, is the largest sand island in the world and is located off the southern Queensland coast, Australia. It is 120 kilometers in length and approximately 24 kilometers at its widest point (Figure 1). It has a residential population of only 195, yet it receives approximately 400,000 annual visitors in the form of daytrips and short term stays. It is a popular destination for local, national and international tourists, with more than 80% of visitors camping within the dunal systems in designated areas along the eastern beach. Access to the island is by barge while access and travel around the island is afforded by the use of 4WD vehicles traversing the eastern beach and sandy inland tracks.

The beaches of K’gari, like any Queensland beach on which vehicles are permitted to drive, are considered gazetted roads under state government legislation. That is, all road rules and regulations that pertain to state government constructed and managed roadways, also apply to the beaches. While this allows for greater regulation, enforcement and prosecution, it is not without complication. A gazetted road permits any person with regular on-road or international licensing is permitted to drive on the beach at up to 80km/hour. However, the beach driving environment is one of rapid change, unstable surfaces, pedestrian priority, and distraction – with limited signage, instruction or road infrastructure. It is a roadway context of vast unfamiliarity for the majority of drivers, further compounded by the necessity of the use of 4WD vehicles traversing the eastern beach and sandy inland tracks.

This unique driving environment on K’gari has resulted in numerous accidents and most significantly 4 fatalities from 3 separate accidents since 2009. Considering the approximately 400,000 annual visitors to the island this statistic, when compared to the mainland road accident statistics, seems relatively immaterial. However, context matters and 96% of the accidents on the island involved single vehicles, and all of the deaths to date involved foreign tourists being killed in single vehicle rollovers. Three of the deaths were as a result of two independent motor vehicle accidents that occurred in April and December 2009. All three of the fatalities were passengers in 4WD hire vehicles being driven by a fellow tourist, who they had only recently met, driving on sand for the first time. The fourth fatality in December 2014 was the driver of the vehicle and this accident occurred on an inland unsealed sand road.

At the time of the 2009 accidents international tourists were permitted to undertake self-drive tours of the island. Since 2011 these tourist groups are required to be part of ‘tag-a-long’ tours. While they still self-drive, they are part of a convoy of up to 6 vehicles that is led by an experienced 4WD operator from the tour company. The most recent fatality occurred while the tourist in question was participating in this type of monitored 4WD excursion.

Prior to departure the designated tourist drivers of the 4WD vehicles are required, by law, to view a 30 minute instructional video, undertake a vehicle inspection and complete a 30 minute test drive of their designated vehicle. This instruction is provided by the tour company.

There is no doubt that beach driving crashes represent a significant problem. As a result, standard road safety interventions are being applied, particularly when visitor numbers are high. These include the use of speed cameras and random alcohol and drug testing. Whilst this is encouraging, the program of research from which this paper
derives argues that the unique context in which beach driving occurs renders the standard road safety approach inappropriate. Despite the fact that beach roads are treated as gazetted roads, they are very different to standard road environments, and, as such, there may be an opportunity to implement new context driven interventions. A first step in determining this requires that the beach driving context be described and understood. In particular, the extent to which the environment and associated crashes are different to standard road environments and crashes needs exploration. In addition, the stakeholders who share responsibility for beach driving crashes should be identified (in order to determine what can be done to prevent them). This paper attempts to fulfil these first steps by exploring the range of actors involved within the beach driving system, along with the contributory factors involved in the recent incidents described above.

1.1. Regulatory environment for beach driving on K’gari

The eastern beach on K’gari is designated a gazetted road and as such the driving environment is managed under a range of legislation. The Queensland Department of Transport and Main Roads (TMR) is responsible for the management and implementation of Transport Operations (Road Use Management—Road Rules) Regulation 2009, which largely constitutes Queensland road rules; Transport Operations (Road Use Management—Driver Licensing) Regulation 2010; and the Transport Infrastructure Act 1994.

Adding complexity to the legislative and beach driving environment on K’gari is the management of the island by the Department of National Parks, Recreation, Sport and Racing’s (NPRSR) Queensland Parks and Wildlife Service (QPWS). The OPWS is responsible for the issuing of access permits which allow vehicles to use the beach as a road, under the Recreation Areas Management Act 2006. The day to day management of the island by QPWS and in line with its world heritage status also has implications for the management of the beach as a road way environment. Under the Federal Governments Environment Protection and Biodiversity Conservation Act 1999, and the State Governments Nature Conservation Act 1992, there are the obligations to manage and protect the island. In part, this means that natural processes which impact the beach environment, such as erosion and the exposure of hazards such as rocks, are left to take their course and not interfered with.

Regulation and oversight of this complex multi-departmental milieu is also undertaken by the Queensland Police Service, with responsibility for enforcement on speed limits and drink and drug driving. Additionally, personnel from the Department of Transport and Main Roads are responsible for vehicle compliance and safety inspections on K’gari beaches.

2. Systems thinking models and methods

The term ‘systems thinking’ in this case is used to describe a philosophy currently prevalent within the discipline of human factors that is applied to understand and improve performance and safety in complex sociotechnical systems [2]. It has been prominent for the last two decades in the area of accident analysis (e.g. [3] [4]) but has also enjoyed significant attention in the areas of systems analysis and design in many areas (e.g. [5][6] [7]).

There are various key tenets (see Rasmussen, 1997 [4]); however, the prevailing philosophy is that safety, and indeed accidents, are emergent properties arising from non-linear interactions between multiple components across complex sociotechnical systems (e.g. Leveson, 2004 [3]).

Rasmussen (1997) argues that systems comprise various levels (e.g. government, regulators, company, company management, staff, and work), each of which are co-responsible for production and safety. Decisions and actions at all levels of the system interact with one another to shape it’s performance: both safety and accidents are thus shaped by the decisions of all actors, not just the front line workers in isolation, and accidents are caused by multiple contributing factors, not just one bad decision or action. A key implication is that it is not possible to truly understand safety and performance through decomposing the system into component parts and examining these parts alone (e.g. drivers, vehicles); rather, it is the interactions between the components that are of interest.
2.1. Accimap

Rasmussen proposes the Accimap analysis framework as an appropriate methodology for understanding accidents in line with his systems thinking inspired risk management framework. Accimap is used to graphically represent accident trajectories, including contributory factors and the causal relationships between them. The output provides a detailed representation of the network of contributory factors that pushed the system in question over its boundary of safe performance. To do so, Accimap decomposes the system in question into the following six organizational levels: 1. government policy and budgeting; 2. regulatory bodies and associations; 3. local area government planning & budgeting (including company management); 4. technical and operational management; 5. physical processes and actor activities; and 6. equipment and surroundings.

Decisions and actions implicated in the causal network at each of the levels are identified and linked between and across levels based on cause-effect relations. As a generic framework that is applicable in any domain, Accimap has been applied in various areas, including outdoor recreation [8], space travel [9], and public health [10]. More recently studies and articles have applied Accimap in the road transport context [11][12][2]. The results have been encouraging. Indeed, Salmon and Lenne (2015) [2] make the strong case that Rasmussen’s approaches are required to make additional reductions in road trauma.

3. Methods – Developing the ActorMap

The analysis described within this paper was developed by researchers with the Centre for Human Factors and Sociotechnical Systems at the University of the Sunshine Coast, Queensland Australia. The ActorMap was constructed from a range of sources, including the findings of inquest into the 2009 deaths from the Office of the State Coroner [13]. The Coroner’s report details the circumstances surrounding the deaths and highlights key stakeholders within the complex actor system. Importantly it describes the circumstance surrounding the hiring of the vehicles; the vehicles specifications; the crashes themselves and the aftermath and actions taken by the range of actors. The identification of further actors was facilitated via documentation review of Federal, State and Local government regulatory environments, including management and policy documentation as it related to both gazetted road environments and driving on K’gari more specifically. Further actors were also identified through a desktop search of community and environmental groups and strategies utilizing both K’gari and Fraser Island as key search terms.

4. Results: Accimap – ActorMap

The Accimap analysis discussed within this paper involved developing an ActorMap of the beach driving system on K’gari (an examination of the systems analysis of the two fatal 2009 accidents is forthcoming (Stevens & Salmon (under review)). This systems depiction shows the levels and range of actors that are involved and thus that share the responsibility for beach driving incidents. While the ActorMap was developed based on the K’gari beach driving system; it is anticipated to be generically applicable to a range of beach driving and off road environments both nationally and internationally.

The ActorMap presented in Figure 2 shows the range of actors that are deemed to play a role in the beach driving system on K’gari and thus to share the responsibility for beach driving crashes. This paper will now discuss each level in turn and highlight further interdependencies, opportunities and indeed conflicts between the actors.

First and foremost the ActorMap shows that there is a diverse range of actors and organizations operating within the beach driving system. There is a variety of international, national, state and local stakeholders, in addition to community organizations, NGOs and individuals that have a role to play in the creation, management and indeed improvement of the beach driving system. They span all six levels of the Accimap indicating that the issues associated with beach driving and beach driving accidents on K’gari are complex and interdependent, and that beach driving crashes are indeed a systems problem that could be dealt with through systemic interventions (not just interventions on the beach such as enforcement). An important implication here is that the decisions and actions of multiple stakeholders across the entire beach driving system will interact to play a role in beach driving crashes.
Rasmussen stresses the importance of vertical integration in systems, suggesting that without it, systems can lose control of safety critical processes. The structure of the ActorMap suggests that there are potentially gaps in both the vertical and horizontal integration across actors. For example when considering policy formulation at the top of the system, down to implementation and monitoring of safety and regulatory interventions at a technical level. Further within this range of organizations there are competing priorities both at a policy level and in decision-making. For example the objectives of Federal Governments Environment Protection and Biodiversity Conservation Act 1999, in line with the world heritage status of K’gari, seek higher levels of environment protection than those afforded under the State Governments Recreation Areas Management Act 2006. Further, the convenience afforded to state and local government authorities by maintaining the beach as the primary transport corridor holds little consideration for the management of critical beach sites as feeding areas for local and long-distance migratory shorebirds. Indeed the priorities and impacts of a range of commercial uses of the beach are outwardly at odds with those of recreational and conservation organisations.

4.1. Government policy and budgeting

There is a significant range of high level actors and/or organisations who reside within the beach driving system. It is important to note that the use of the coroner’s report to establish the ActorMap has necessitated the inclusion of the Queensland State Coroner at this level. Further, when considering the beach driving system it has been necessary to also include ARRB Consulting, the authors of a 2005 Road User Safety Review of driving on Fraser Island. This document made 35 recommendations for safety of the beach driving and international tourism (following concerns for safety prior to 2005), however these were not implemented until after 2009 fatal accidents.

There is significant international representation – UNESCO – and associated federal government responsibility; including the recent (November 2014) Native Title recognition of the Butchulla people. This has implications and requires a new closer working relationship between Department of National Parks, Recreation, Sport and Racing, the state government more generally and the Butchulla tribe. This Indigenous Land Use Agreement strengthens the Butchulla people’s ability to enjoy and protect their rights and interests over their traditional lands and waters. It allows them a necessary role in the future use and management of the island, including issues of flora and fauna protection and importantly the appropriateness of facilities and tourist access on the island.

Fig. 2. ActorMap of beach driving on K’gari.
4.2. Regulatory bodies and associations

Queensland Police and the emergency services more generally have a significant role to play, with the former currently involved in driving enforcement activities and the latter involved in shaping the response to beach driving incidents. By virtue of the limited access to the island it is a remote location and emergency assistance is not afforded immediately when required. Indeed there is a necessary link here through the Local government and company management level to the technical and operational level of this system that deals with the affordability of mobile phone coverage by the Telco’s for the entire eastern beach. The local council and island communities have objected to the location of the necessary phone tower on aesthetic grounds, but of concern is the conflict in placement which would in fact limit the ability of emergency service helicopters to land safely.

Other important roles are played out at this level. The Parks and Wildlife Service share some responsibility for the state of the inland roads and often engage in road maintenance activities. At this level there is both conflict and opportunity between Queensland Tourism Board, Parks and Wildlife Service and Police. K’gari is a major international tourism destination, yet a balance between, tourist numbers, driving safety and environmental protection of the beaches is yet to be achieved. There are in fact no accurate records describing the number of tourists visiting the island and there are few limitations (for what?), further there are few academic studies that explore the impact of the beach as a road on flora and fauna.

Interestingly at this level all of the identified actors are state government based or indeed reliant on funding from the state government. Much of their capacity for change, cooperation, or the implementation of policy or programs is tied to the budgetary considerations and current political perspectives or appetite for specific portfolios. There is limited ability then for independent approaches or thinking beyond a particular party doctrine – a significant constraint within this system.

4.3. Local government and company management

This level contains a mix of state and local government; community; and commercial based actors and organizations. These agencies are responsible for much of the integration and implementation of their respective policies including regulation and monitoring. The role of environmental advocacy groups is strongest here, with a larger scope for ‘free voices’, unencumbered by politics or party policy. These organizations, along with those of business representation have the capacity to lobby strongly to the regulatory bodies above, and influence the technical and operations levels below.

Importantly the Fraser Island Traffic Accident Committee is embedded at this level. In 2009, this group was charged with progressing the recommendations of the 2005 ARRB Report. This committee comprises a government response to who they believe are most responsible for traffic accident on K’gari, and includes Queensland Transport; Department of Environment and Heritage Protection; Queensland Police and the Fraser Coast Council (local government). While there are important links established here between operations and policy, it reflects only a governmental response to an issue which is far more complex and with many more actors. Such an approach is left at the whim of budgetary constraints and political motivations, potentially eroding key functions and further inhibiting the safety of beaches as roads.

4.4. Technical and operational management

The technical and operational management level contains actors who are responsible for the actual facilitation of the act of beach driving on K’gari. Here we can recognise not only the companies that are responsible for the hire of 4WD, but also the companies who offer the tour packages and are responsible for the training of inexperienced 4WD operators. The actors at this level represent the public / private interface where much of the necessary intervention is required to ensure that education and information is disseminated and shared between the users of the beach as a road.

Uniquely within this system, because the beach is the road, there no technical actors responsible for the operation or management of the physical roadway. These tasks are taken care of through the natural processes of storms and tides. Further, this stripped back roadway system has only two major practical elements, and actors, which impact
the levels of safety and response when driving on K’gari. These are the actors concerned with the design and manufacture of 4WDs; and the actors which represent the Telcos and the affordance of on-island mobile phone coverage.

Since the fatal incidents of 2009 there have been some legislative and policy changes which have had operational consequences. For example, the number of tourists within each vehicle is limited to 8, and each must have their own forward facing seat. Additionally the introduction of the tag-a-long tour, in lieu of self-drive tours has become mandatory. These changes have had implications for the physical processes level of the beach as a road ActorMap.

4.5. Physical processes and actor activities

The physical processes and actors activities level represents the beach driving activity itself within the beach environment. The actor interactions at this level are critical to the safety of the beach as road. The key actors at this level are of course the drivers; however, it has to be noted that other important actors are present. For example, other beach users, such as those engaging in recreational activities (e.g. fishing, sunbathing, physical exercise, dune walking) can enter and depart the road as and when they like. In addition, aeroplanes transporting tourists and offering scenic flights often land and take off from the beach. These actors who interact with drivers represent another critical and unique aspect of beach driving.

The capacity of the drivers to operate an unfamiliar vehicle; the appropriate role and responsibility of passengers within these vehicles to behave in a safe and supportive manner. In fact it was the interactions and the actors at this level (and the equipment and surroundings level below) that were the focus of the Coroner’s report, when it apportioned much of the responsibility for the fatal accidents in 2009. Considering the tourist experience, what may be recognised is that the relationship between the driver and the passenger is largely one of unfamiliarity and this changes the dynamic and often the ability for individuals to seek, or speak out about responsible behaviours.

The levels of driver training and the appropriateness of that training must be considered here. Considering the international nature of the tourists visiting the island, it is reasonable to expect that English is a second language for many. The domestic response to driver training for beach driving, is largely to undertake the activity and to learn as you go. Owners of their own 4WD vehicles are not required to undertake any specialist training prior to driving on K’gari, or indeed any beach roadway environment in Australia.

A final feature of beach driving is the fluid nature in which it unfolds. Indeed, what is unique about this driving environment is the role that other beach users and beach drivers play in community driver safety. While the keep left rules apply under Queensland law, when driving on the beach it is not uncommon for oncoming traffic to pass to either the left or right of you depending on beach conditions. However it is convention for drivers to use their vehicle indicators to shown their intentions.

4.6. Equipment and surroundings

This level of the ActorMap highlights the equipment and surroundings underpinning beach driving. Again, the compelling finding is that the environment is entirely different to conventional road transport environments. Since the beach itself provides the road surface, there are no formal road markings, the path to take shifts throughout the day, and the surface is uneven, variable, and is often impinged upon by water, debris and other natural materials. Supporting infrastructure is minimal, with very little regulatory signage, beyond occasional speed limits as drivers near one of the islands three beachside communities. There are no formal roundabouts, intersections or road lanes.

The driving environment is also impacted by the actor decision-making undertaken for the location of the designated camping sites along the eastern beach. Drivers may have to cover significant distances to find sufficient space for their camp, or indeed a site that they feel is most ‘away from it all’. This driving occurs against a backdrop of time limitations as the best time for beach travel is two hours either side of the low tides. As such it is during these hours that there is peak movement of vehicles along the beach adding additional constraints to the safety of the beach driving system.

Distraction of the driver is also a significant risk for beach driving – there is much to look at, yet there is also the uncertainty that comes with limited signage or indeed landmarks to measure your journey. The driving environment is without many distinguishing features, simply the ocean or the brush covered dunes. Further the lack of posted
speed limits allows for creep and uncertainty on what should be considered a safe speed. Distances and itineraries all become uncertain when the road is simply a beach which is managed and maintained by natural processes alone.

A final important feature at this level is the presence of other vehicles that influence driving behaviours. The presence of aeroplanes has been discussed but other unique forms of vehicles include 4WD tour buses; trucks for waste management and even ship wrecks on the beach (e.g. the SS Maheno 1905 - 1935).

5. Conclusion

The aim of this paper was to examine the stakeholders residing within the beach driving system on K’gari, a sand island off the South Coast of Queensland, Australia. The intention was, first, to identify those who share the responsibility for beach driving crashes, and second, to identify differences between the K’gari beach driving system and conventional Australian road systems. These lines of inquiry are important as they determine what interventions should be introduced and who could develop and introduce them.

The first important conclusion from the ActorMap presented is that, like all complex sociotechnical systems, the beach driving system on K’gari is a complex one that comprises many different actors and organisations across many different levels, including the higher government level. The ActorMap shows a diverse range of actors and organisations, covering international, national, state and local stakeholders. According to Rasmussen’s risk management framework, the decisions and actions of all of the stakeholders identified interact to play a role in beach driving crashes.

A second, and inescapable conclusion is that despite being classified as a gazetted road, the K’gari beach driving systems represents a unique driving system and one that is entirely different to conventional Australian road transport systems. Although actors and organizations span both, the nature of the K’gari beach driving system is vastly different, particularly at the lower levels. The ActorMap depicts a driving system in which recreational beach goers can freely interact with cars travelling at 80km/h, in which vehicles can operate on either side of the road, and in which planes can take off and land using the same ‘road’ surface. In addition, there is an absence of formal road infrastructures and the road itself shifts and changes dynamically. An important implication of this finding is that a conventional road safety approach to crash prevention is likely to be inappropriate. In short, a beach driving specific response is required. What this response should entail forms a critical research agenda that involves understanding beach driving crashes and the beach driving environment and developing appropriate interventions.

References


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