Post-Disaster Decision Making in Road Infrastructure Recovery Projects –
An Interview Study with Practitioners in Queensland

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ABSTRACT: *The repair and reconstruction of road infrastructure plays a vital role in the recovery process after a disaster event and will be affected by the decision-making processes adopted by asset owners. The objective of this study is to understand how road asset owners assess and prioritise road reconstruction projects in order to identify how decision making could be improved in real-life post-disaster scenarios. This paper presents results of in-depth interviews with road infrastructure practitioners in Queensland, on decision making in a post-disaster context, using a case study based approach. A number of challenges were identified including the lack of a common decision making platform, the lack of focus on the socio-ecological impacts during decision making and the importance of community engagement during the reconstruction process.*

Introduction

With the occurrence of natural disasters increasing in recent times the exposure and vulnerability of major infrastructure to such events has increased. The vulnerability of road infrastructure increases with the rise in the number and intensity of hydro-meteorological disasters. With multiple disasters occurring in the same area the importance of good decision making in repairing and reconstructing damaged assets becomes evident. Floods and storms are the most common type of disasters in Australia (Guha-Sapir, 2016) and the State of Queensland is one of the most vulnerable states to such events (Coates, 1999).

Road structures play an important role in the recovery of disaster hit communities as it provides the means of access, which is vital in a post-disaster context. The rescue, recovery and reconstruction efforts will rely heavily on the accessibility to the disaster-zone and with the lack of serviceable roads and bridges, such efforts could be hindered (Gajanayake *et al.*, 2018). It is thus evident that the reconstruction of road infrastructure after a disaster event is vital, so as to minimise the follow on impacts it may cause to the community and the economy.

The purpose of this paper is to examine how decision making with regard to post-disaster reconstruction of road infrastructure is carried out in a disaster-prone region in Queensland, Australia. The paper presents the factors influencing decision making and the methods and techniques used by practitioners in prioritising reconstruction projects based on information gathered through a series of semi-structured interviews.

Factors influencing road reconstruction decision making

The effectiveness of post-disaster reconstruction will depend on numerous factors while the availability of resources after an event is a major factor affecting the reconstruction processes (Chang *et al.*, 2012). Other factors that influence the reconstruction activities are the influence of funding agencies on the decision making and prioritisation processes and the coordination between funding agencies, road authorities, central and local governments (Le Masurier *et al.*, 2006).

Lyons (2009) explains that post-disaster decision making is heavily influenced by economic and political actors, with less influence from grass root level. Therefore, reconstruction activities especially in rural areas tend to be centrally planned and managed with heavy influence from large actors and little focus on tapping into local knowledge (Peng *et al.*, 2013). A disaster may lead to insufficient local capacity required for the rebuilding process and hence there can be potential for larger scale organisations to fill these local gaps (Haigh and Sutton, 2012).

Post-disaster reconstruction activities are generally carried out based on disaster management and recovery plans, which have been specifically designed for this purpose. The lack of a clear disaster management plan has been found to delay the reconstruction activities due to lack of clarity in who needs to take responsibility (Pathirage *et al.*, 2012) and unclear lines of authority (Lin Moe and Pathranarakul, 2006). However, most regions or countries only develop such plans as a reactionary effort after a major disaster event and is specifically the case with areas which are not prone to major disasters (Palliyaguru and Amaratunga, 2008). In addition to well-prepared disaster management plans and funding strategies a comprehensive method to prioritisation can improve reconstruction processes. Such prioritisation frameworks integrate technical factors of specific infrastructure and societal influences allowing for individual and system level assessment of structures (Liu *et al.*, 2016).

Research methodology

The aim of the present study is to gain in-depth knowledge on how practitioners assess impacts and prioritise reconstruction projects in resource constrained post-disaster situations. Given the exploratory nature of the study, a qualitative approach was adopted, involving a thematic analysis of interviews carried out with practitioners in Queensland, Australia. Ethics approval for the research was obtained from the RMIT University Human Research Ethics Committee (SEHAPP 75-17).

Interview design

A semi structured interview technique was identified as most suitable for the purpose of the study. The questions were designed with a clear theme and fairly limited focus, but within the frame the questions were open ended in terms of structure. Particular themes were chosen for more rich description, focussed exploration and deeper understanding (Alvesson, 2010).

Typically the responsibility of maintaining regional roads fall under the local authority or the regional roads authority, while funding for post-disaster reconstruction is facilitated by the reconstruction agency. A total of ten interviewees (Table 1) from these organisations were identified through previous research work carried out by the authors and were contacted directly by the research team.

Table 1: Respondents for the interviews

Organisation	Division	Number of respondents
Regional Council in Queensland	Infrastructure Works and Services	1
	Disaster Management	2
	Environment and Pest Management	1
	Economic Development	1
	Community Development and Engagement	2
Queensland Government	Engagement and Technical Services, Operations	1
	Program Delivery and Operations	2

The interview questions and a Participant Information Sheet were emailed to the respondents a week prior to the interview. The interviews were typically 30-60 minutes in length and were conducted face-to-face at a meeting room at the interviewee's office. The interviews were carried out during 2018 as one-off interviews, although the research team reached out to some interviewees afterwards to clarify issues.

Data analysis

The interviews were transcribed by the interviewer himself so that any emotional overtones and nuances captured in the interviews were not lost in the transcripts. The interviewer doing his own transcribing also helps in building familiarity with the data, which is useful for the analysis (Bazeley and Jackson, 2013). The interviews were transcribed verbatim, which increased objectivity during the analysis by avoiding the researcher to be guided heavily by pre-existing ideas or jumping to conclusions without carefully having looked at and interpreting the interview material (Alvesson, 2010).

The transcripts and notes were coded in order to capture the essence of the interviews. The in-vivo coding method, where coding words are selected from a phrase or word from the transcript itself, was used for generating the codes (Miles *et al.*, 2014). This method ensures that concepts do not diverge from what was described by the respondents and also prioritises and honours the participant's voice. An inductive coding approach was used to create the specific codes, where codes are determined progressively during data collection and analysis (Miles *et al.*, 2014) while pre-determined codes were avoided so as to reduce interviewer bias in the coding process. The coding was used to generate pattern codes, which were used to form themes emanating from the interviews.

Results

The results obtained are presented in this section under five major themes, which eases understanding and the flow of ideas generated through the study. Some sections also include quotes taken from the interview transcripts. These quotes have been presented in order to draw attention to specific important ideas that were mentioned in the interviews.

The importance of social factors

A majority of the interviewees mentioned that social impacts were the most critical type of impact ahead of economic and environmental impacts and they considered it important to minimise such impacts. The idea that road infrastructure facilitates the smooth functioning of the community was echoed by most interviewees regardless of their professional background or department they represented.

"A bridge is not just a bridge, but a whole bunch of other implications [are associated with it]."

The objectives and deliverables of most of the departments and organisations interviewed were linked to social factors. This was especially evident with those interviewed

from the Council. However, as no official documents were analysed by the authors as part of the study, it is not evident whether such social factors were highlighted purely due to the focus of the interview. It was observed that each department had aligned social factors with their departmental objectives in diverse manners. For example, infrastructure departments mentioned that the purpose of road infrastructure was to ease community impacts, while the environment division mentioned that the protection and enhancement of the natural environment was ultimately for the social wellbeing of the community.

A diverse set of impacts were identified by different interviewees as the most important type of social impact such as human health issues, access to facilities, inconvenience to communities and traffic related impacts. A very common social impact that was highlighted was that of isolation of people or households due to damaged roads. Isolation of communities was highlighted especially by interviewees working in more rural environments in contrast to those focusing on more urban settings. One interviewee from a regional council mentioned that isolation is one of the most critical factors that needs to be considered but is something that is overlooked by practitioners who work in urban areas.

"The more you think about it, everything affects the human social side of it".

Although social impacts were stated as the most important category, it was noted that methods to assess social impacts were lacking. The lack of such methods was seen in council and even in State decision making processes. It was agreed by the interviewees that a commonly accepted method to assess social impacts would be beneficial for infrastructure related decision making. It was also pointed out that although the measurement of social impacts were important, care should be taken to decide on the methods used to assess them and how the outcomes are interpreted by the decision makers.

Lack of focus on environmental impacts
The interviews highlighted that environmental impacts were the least analysed impact category. The reason for this was seen to be that social and economic impacts were considered to be more critical resulting in a lack of focus on the assessment of environmental impacts. A direct link between the natural environment and the socio-economic impacts were recognised by interviewees from the community and environment divisions, whereas reference to such links was not identified by engineers.

The environment, economic and community divisions within the council saw that the natural environment affects the socio-economic impacts of residents while the disaster management division was focussed more on how impacts on the environment will influence vulnerability to natural hazards. There was seen to be an increase in the involvement of environmental practitioners in disaster management work within Councils and this could be attributed to the heightened awareness of the links between the natural environment and the socio-economic aspects.

> *"A lot of the environmental issues are actually at the root of social and economic issues as well."*

The most important environmental impacts that could occur during the reconstruction process were identified as soil erosion, effects on water quality and sediment run-off. This was in contrast to other studies where the focus of environmental impacts was resource usage and greenhouse gas emissions during to the reconstruction phase (Padgett and Tapia, 2013; Schweikert *et al.*, 2018). Interestingly resource usage and greenhouse gas emissions were not highlighted by a single interviewee. The reason for this could be that the interviews were focused in a regional disaster-prone area, where a link between the natural environment and disasters are directly observable and take precedence over global environmental issues.

> *"Because an infrastructure solution may have a negative environmental [impact]... we need to talk together... [to] try and get a more holistic outcome with decision making."*

The interviews exemplified that there were diverse opinions in thought on the best way to approach reconstruction in order to increase resilience. One group viewed the solutions from an engineering stance while others opined that a purely technical solution may in reality aggravate the consequences due to the interdependence of engineering solutions and the natural environment.

Post-disaster decision making processes

The interviews exemplified that there was no systematic method used to assess wider impacts of road infrastructure failure and to prioritise the reconstruction of assets. The only systematic processes that were utilised in post-disaster decision making were those used to estimate the reconstruction costs, which were stipulated by funding agencies. Such funding proposals tend to focus on the financial cost of reconstruction with minimal consideration given to wider socio-economic and environmental impacts.

Although wider impacts had not been assessed methodically, such impacts were not completely abandoned during decision making. Most decisions were made on "gut-feel" and the possible socio-economic impacts were considered based tacit knowledge of practitioners in past experiences and the intimate knowledge of the locality. It was highlighted that in a rural setting local knowledge may play a far more important role in identifying social impacts rather than a set system or method.

The interviewees did not seem to think that the decisions that were made in this manner could be completely flawed, but saw the need for a framework that could validate the current decision making processes. It was also highlighted that such a method could be used for numerous purposes including, as an evidence base for funding proposals, prioritisation of projects and the comparison of alternative reconstruction methods. Such ideas were seen across all organisations with the idea that a common tool, which can be used across different organisations, would be beneficial in State level disaster management.

> *"It's just really gut feel…. So we'll do it in our heads but if we were questioned later on, we have no record of how we made that decision."*

Political aspect

Some interviewees were of the opinion that political aspects can influence post-disaster decision making and prioritisation. It was mentioned that there may be encouragement given to concentrate on specific areas during the reconstruction processes, purely from a political perspective. In instances where a follow up question was asked, there was hesitance to explain further stating "you know what I mean".

> *"In the real world sometimes it gets political, noisy wheels get the oil."*

However, one interviewee stated that political factors actually may highlight other underlying socio-economic factors that may not have been identified, especially from State authorities. For example a bridge located close to a specific business entity may get political consideration, and it may well be that the business was a large contributor to the local economy, which was not immediately highlighted to state authorities.

Community engagement

Another aspect that came up in the interviews is the importance of engaging and managing community expectations during the recovery and reconstruction stages. It was highlighted that the residents were not too pleased with the way that the reconstruction took place and this increased the level of frustration among the community. It was pointed out that clarity

and openness of communications would give the residents some peace of mind although it wouldn't necessarily speed up the recovery process.

> *"People say bloody Council haven't fixed that bridge yet. But they don't understand the NDRRA process and how complex that can be and time consuming."*

The introduction of regulations that limit individual recovery actions could also exacerbate such frustration among the community. With limitations to clearing of debris in streams, clearing roads and using farm vehicles for transportation the community had to solely rely on the Council and State authorities to facilitate their recovery process. Some respondents were of the view that legislating such community recovery actions had an unintended consequence of reducing the resilience and adaptability of communities.

Interviewees commented that there were times when disagreements between communities and engineers involved in reconstruction work have ensued. Such disagreements mainly arose when experts who did not possess the necessary local knowledge were brought in and they were resistant to listen to the local farmers. Many interviewees were of the opinion that the residents had the local knowledge of the creeks and the geography and that such knowledge needed to be tapped into during the recovery process.

> *"But the farmers weren't saying this is how you build a bridge. They were saying, this is where we need a bridge and this is the order that we need them."*

Discussion and conclusion

These interviews have shown that there are two schools of thought among practitioners on the most appropriate methods of disaster reconstruction: one being technical engineering solutions and the other by giving more consideration to socio-ecological issues. These two schools of thought can be categorized as engineering solutions and ecological solutions respectively (Raab, 2017).

The results indicate that post-disaster decision making in the region studied is conducted utilising practitioners' tacit knowledge on the locality and past experiences. Such methods can be advantageous especially in more regional areas where standardized state level disaster recovery plans may not be appropriate. Further it was understood that the adoption of state level regulations intended to protect people can have unintended consequences that decrease resilience and recovery of communities in more rural regions. State level authorities

can look at methods where recovery guidelines could be modified by local authorities to better suit the specific regions, which may increase the resilience of the communities.

Another finding is that more effort needs to be taken to engage with the community so as to bridge the gap between the people and the authorities. Interestingly it was found that community engagement was carried out during housing reconstruction in the same region (Okada *et al.*, 2014) but not during the reconstruction of infrastructure. One reason for this may be that housing reconstruction is considered a societal issue while road reconstruction may be more an engineering problem. Distrust felt by the people towards authorities have been identified in post-disaster reconstruction efforts (Shaw and Goda, 2004) while community acceptability of projects is perceived to be very important by decision makers in the public sector (Vu *et al.*, 2018) indicating the importance of effective community engagement practices during reconstruction.

State level authorities could also look at how the soft sciences could be incorporated into the decision making process improving on the current processes which are predominantly engineering focussed. Such methods could help the organisations retain the tacit knowledge of the practitioners, which will ease decision making in the future, while increase community acceptability of reconstruction projects (Thanurjan and Indunil P. Seneviratne, 2009).

The present study set out to understand the decision making processes in road reconstruction activities in a disaster-prone area in regional Queensland. A number of challenges were identified including the lack of a common decision making platform that could be used across different agencies, the lack of focus on the socio-ecological impacts during decision making and the importance of community engagement during the reconstruction process.

Acknowledgements

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