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Informing regulatory reform in Australian industry through mixed research: A post-hoc evaluation of research design

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ABSTRACT

Despite the growing importance of sustainability and increasing industry and government concern about properly managing for sustainability, the use of mixed methods research to inform sustainability management issues in business is limited. For the Australian rail industry environmental regulation is a regulatory hotspot. The industry initiated a project to investigate the case for rail environmental regulatory reform. Research was undertaken in an integrated three-phase mixed research design, involving pilot case studies, review of academic literature and industry records and in-depth interviewing. Key findings from each phase are reported. This study is evaluated post-hoc in terms of recently published guidelines for conducting and reporting mixed research. The quantitative and qualitative findings from all three research phases suggest that the time is ripe for a more co-regulatory approach to rail environmental regulation. The paper is of interest to mixed researchers, as well as managers and regulators striving for more sustainable regulatory approaches.

Keywords: mixed method research, regulatory reform, Australian industry, mixed research typology, rail transport, sustainability, environmental regulation, case study, inventory, in-depth interview, multiple stakeholders, NVIVO

Introduction

Mixed methods present an alternative to quantitative and qualitative traditions, by focusing on the use of whatever methodological tools are required to answer the research questions under study (Teddlie & Tashakkori, 2009). As noted by leading mixed method researchers, Tashakkori and Teddlie (2010), in their latest handbook, the landscape of mixed method research has changed dramatically in the last 7 years with the publication of many significant works. Yet the mixed methods paradigm is still relatively confusing to many researchers (Leech & Onwuegbuzie, 2009). Mixed method resources can be difficult to locate due to the lack of common terminology (Plano Clark & Creswell, 2008). These problems are especially evident in the management discipline. For instance, in a systematic review of 197 referred empirical management papers, Cameron (2008) found that just 14% used a mixed method design, of which only 18%, in turn, used an integrated mixed method design. While management education and development and research methods have the strongest

mixed method tradition, mixed research tends not to feature in a number of other management streams, including sustainability issues in management (Cameron, 2008).

The recent emergence of sustainability as a 'mega trend' (Lubin & Esty, 2010) may account for the dearth of mixed method research into sustainability issues in management. As awareness of the significant environmental degradation and social inequities around the world increases, the call for sustainability is affecting corporate strategy, consumer decision-making and government policy. A particular sustainability-related issue for business is the expanding volume and reach in recent years of the regulation of business' environmental impacts. While regulation is an important vehicle for achieving national economic, social and environmental (i.e., triple-bottom-line) objectives, the Regulation Taskforce (2006) argued that much regulation is poorly justified and implemented. The thorniest problem emanating from the rise in environmental policy enthusiasm is that it may result in regulatory over-burdening or unilateral decision-making on the part of regulators, with the potential result of reducing confidence levels with respect to doing business or investing in Australia. This situation could add further levels of complexity in dealing with sustainability issues and thereby reduce efficiency and discourage investment in key infrastructure sectors, such as transport and utilities that see to the realisation of important public values (de Bruijn & Dicke, 2006; Koppenjan et al., 2008).

One Australian industry particularly encumbered by the burden of environmental regulation is that of rail transport. The rail industry consists of a complex, fragmented network of publicly and privately-owned urban, regional and interstate freight and passenger operations and owners, which has been profiled in a range of recent publications (e.g., BTRE – Bureau of Transport and Regional Economics, 2006; NTC – National Transport Commission with Booz and Company, 2009b; von der Heidt et al., 2008a). Ranged against this background are separate regulatory regimes for safety, access and economic functions and environmental impacts, all of which are overseen by a mix of State government agencies and the Commonwealth. Within the rail industry, these various regimes are regarded as leading to inefficiencies, while the need to comply with different and sometimes contradictory laws is believed to create unnecessary red tape.

Rail environmental regulation (RER) is perceived by the industry to be in thorough need of improvement. As discussed elsewhere (von der Heidt, Charles, Ryan, & Hughes, 2008), the desire for environmental regulatory reform arises from the problem of allocating regulation under the framework of Australian federalism and the diffuse nature of regulation to abate environmental externalities. Yet no government or industry initiative has investigated the nature and burden of environmental regulation imposed on Australian business. To address this information need and to, potentially, influence the structure of regulation to increase the rail industry's competitive position (Jaworski, Kohli, & Sahay, 2000), the Cooperative Research Centre (CRC) for Rail Innovation initiated a 1-year industry–university collaborative research project.

This paper is set out in two main sections. The first section describes the study, which was designed to 'fit the purpose'. The methodologies employed are outlined and key results from each of the three research phases are presented in turn. A post-hoc assessment of the study in terms of mixed research design is undertaken in the second section. Two different mixed methods classifications are applied to the study – the mixed method continuum and a three-dimensional typology of mixed method designs. The study is then evaluated in detail using Leech and Onwuegbuzie's (2010) guidelines for conducting and reporting mixed research in the field. Finally, the implications for rail environmental regulatory reform are discussed.

A STUDY OF RAIL ENVIRONMENTAL REGULATION

The study aimed to develop an informed understanding of environmental regulations pertaining

to rail in terms of regulatory coverage, regulatory quality, and regulatory activity in 2008–2009, especially regulations pertaining to greenhouse gas emissions, particulate emissions, and noise. This information together with an analysis of potential solutions provides the industry with a better platform from which to guide and influence policy pertaining to rail's operating environment – both on the track and in maintenance areas. In this way, rail is better able to exploit its comparative advantage with regard to environmental impact vis-à-vis competing higher-impact transport modes.

The research project was resourced in terms of a small team of researchers – a research fellow (80% FTE[1]), a research assistant (50% FTE), a project leader (5% FTE) – and a 1-year budget. The immediate problem facing the team was the absence of a knowledge base on regulation of rail's environmental impacts. To gain a maximally complete picture of RER in Australia from different stakeholder perspectives, a triangulated mixed method study was designed, i.e., one involving the use and reporting of multiple data gathering techniques (usually three) to investigate the same phenomenon (see, for example, Babbie, 1989; Berg, 2007; Neumann, 2003). Hence, the project was planned in three progressive phases over 1 year:

1. A review of academic and industry literature as well as pilot case studies to develop initial insight into the nature of RER and the business case for change (3 months).
2. A review of internal rail firm documents, government and academic literature to map (inventory) and evaluate the current regime of RER (primary, subordinate and quasi-legislation and guidelines) across all jurisdictions in Australia (federal and state; 4 months).
3. Qualitative in-depth interviews with key rail and regulator stakeholders to gain insight into their assessments of current RER and reform possibilities (5 months).

Each phase was implemented as planned, whereby actual completion was approximately 6 months after the target date. This was mostly due to the lengthy industry review processes of the reports for each of the three phases. Key results from each of the three study phases are set out in the next sections.

Key results from phase 1: The case for change

An in-depth review of the rail industry, regulation and environmental literature indicated that there was little published information and understanding regarding the nature and extent of inconsistencies in environmental legislation and regulation that impact on Australian railway operations (von der Heidt et al., 2008a). However, some inroads were made toward mapping the key environmental regulatory areas of interest (e.g., greenhouse gas emissions, air pollution, noise, dust, site contamination, biodiversity conservation). This stage of the research involved exploring the distinctions between the three forms of regulation (government, self-regulation and mixed regulatory strategies, namely co-regulation), as well as their relative costs and benefits.

The available literature was supplemented by first-hand industry insights using pilot case studies (Yin, 1984). In interviews with five rail operators and track owners, eight case studies were developed, highlighting concrete problems caused by current RER. This provided initial evidence that there is a multiplicity of regulatory regimes and styles of regulation covering rail operations (both train and track), as well as a multiplicity of regulation and regulatory practice for different individual environmental aspects (such as noise, vibration, dust, emissions, etc).

Based on the literature review and the case studies, force-field analysis was used to indicate the general pressures for and against changing current RER (see Figure 1). This is a method proposing that two sets of forces operate in any system – forces

[1] Full-time equivalent.

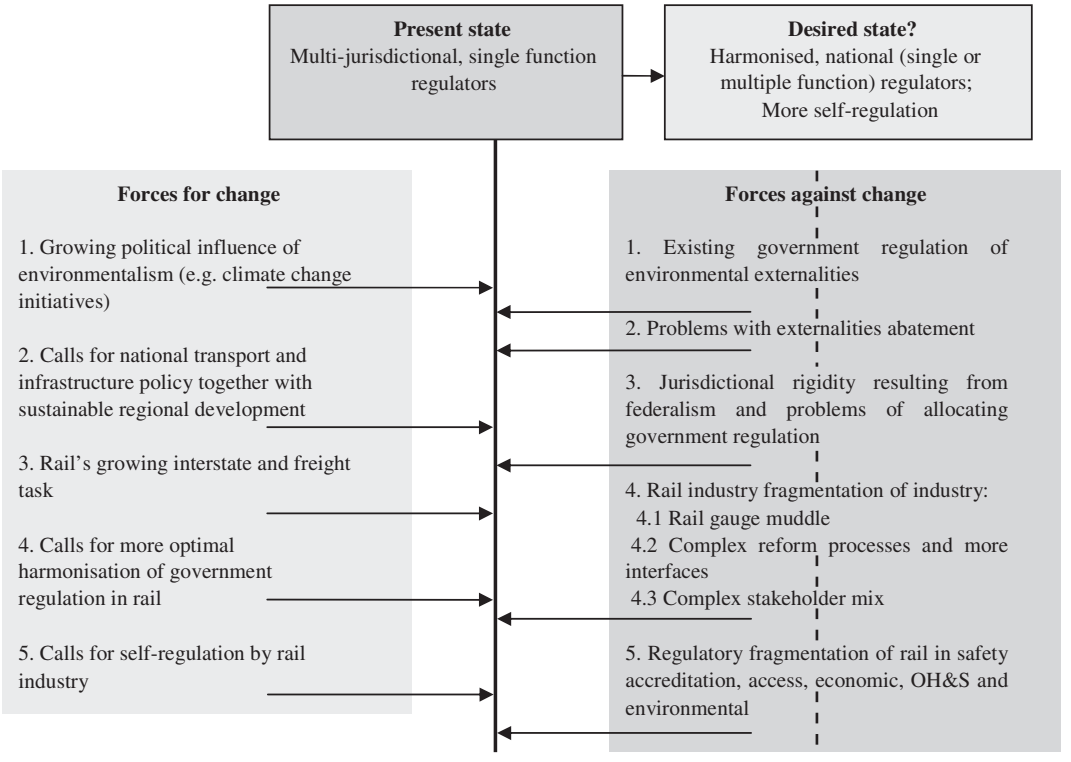

FIGURE 1: INITIAL FORCE-FIELD ANALYSIS OF RAIL ENVIRONMENTAL REGULATION (VON DER HEIDT ET AL., 2008A)

that operate for change (driving forces) and forces that operate against change (resisting forces). If the two sets of forces are equal in strength, the system is in equilibrium (Robbins, Bergman, Stagg, & Coulter, 2003). An important part of applying this analysis is arriving at specific ideas regarding how resisting forces can be reduced. Clearly, forces outside the industry tend to be more difficult to manage, such as Australia's federal system, government policy on environmentalism and transport, government's responsibility for regulating environmental externalities, and difficulties in the abatement of environmental externalities. Internal (industry) factors are more controllable and hence more conducive to change. Therefore, an interim conclusion of the RER study was that harmonisation of environmental regulations can potentially be achieved by strengthening industry's: (a) calls for more optimal government frameworks, processes and regulations; (b) capacity to self-regulate by moving beyond quantitative regulatory targets; and by (c) working toward overcoming industry fragmentation through appropriate forms of industry cooperation on the matter of regulation.

Key results of phase 2: Inventory

The second phase of the research project involved mapping out or quantifying RER in relation to 16 environmental issues, which emerged from Phase 1, including air pollution emissions, waste efficiency, flora and fauna, sustainable development, land contamination, water efficiency and noise emissions. Data was drawn from a range of sources, including the websites of the government environmental regulator in each jurisdiction (eight state and four federal) and, where available, the environmental legal and other requirements register or compliance register for rail industry members (11). In total, documents pertaining to RER from 23 different organisations were content analysed.

Table 1: Overview of rail environmental regulation by type and jurisdiction

Jurisdiction	Legislation	Quasi-legislation	Co-regulation	Self-regulation
Western Australia (WA)	26	22	0	2
New South Wales (NSW)	24	9	3	5
Victoria (VIC)	24	7	2	3
Queensland (QLD)	21	2	0	3
South Australia (SA)	17	2	1	0
Tasmania (TAS)	10	3	1	0
Australian Capital Territory (ACT)	8	0	0	0
Northern Territory (NT)	6	1	0	0
Commonwealth	15	10	2	14
Total	151	56	9	27

As a result, the first comprehensive inventory of rail environmental self-regulation, government regulation and co-regulation pertaining to a range of environmental impacts of rail across all Australian jurisdictions was developed (von der Heidt et al., 2008b). Overall, 151 pieces of environmental primary and subordinate legislation were identified. In addition, 56 pieces of quasi-legislation (e.g., guidelines and strategies) relating to rail's environmental impacts were found. An overview of regulation by type and jurisdiction is shown in Table 1 and an overview by type and environmental issue is shown in Table 2. Only nine examples of co-regulation (industry/government cooperation in developing regulation) of environmental issues pertaining to rail were found. In terms of self-regulation, around half of rail organisations are in the process of completing and implementing an environmental management system (EMS) and claim to comply with ISO 14001: 2004, or an equivalent.

In addition, RER was evaluated in terms of regulatory burden, regulatory quality and isolated regulatory activity as per the Regulation Taskforce (2006). The Inventory provided quantitative evidence of a multiplicity of Commonwealth and State-based environmental regulatory regimes for most of rail's various environmental impacts, indicating considerable scope for improvement in working toward a more effective environmental management and performance framework for Australia's rail industry. Consistent with the mixed research guidelines 'reformulation of research question', a set of recommendations for further investigation were specified. These recommendations were classified within (1) strengthening industry's ability to self-regulate; (2) strengthening co-regulation by industry and state/federal government regulators; and (3) improving government regulation (von der Heidt et al., 2008b).

Key results of phase 3: Stakeholder views

Building on the prior two phases, the third, most dominant phase of the RER study aimed to understand the complex RER phenomena from the viewpoint of expert individuals in key rail and government stakeholder groups, as well as to test researchers' ideas on reforming RER. This called for qualitative research (or in-depth) interviews. This data collection method attempts to understand the world from the subject's point of view, to unfold the meaning of their experiences, to uncover their lived world prior to scientific explanations (Kvale & Brinkmann, 2009). Because it allowed for knowledge to be constructed in the interaction between the interviewer and the interviewee, the 'inter-view' was an appropriate way to explore with the participant the problems associated with the efficacy of the current regime of environmental regulation, opportunities to reform the regime in terms of the three regulatory

Table 2: Overview of rail environmental regulation by type and environmental issue (von der Heidt et al., 2008b)

Environmental issue	Legislation	Quasi-legislation	Co-regulation	Self-regulation
General	21	5	–	1
Air pollution emissions	20	4	–	1
Waste efficiency	18	4	–	1
Flora and fauna (biodiversity)	16	4	1	1
Sustainable development	16	17	1	2
Land contamination	14	3	–	1
Water efficiency	11	3	1	1
Noise emissions	10	3	4	3
Water quality	9	1	–	1
Pest management	5	2	1	1
Ozone	4	–	–	1
Land degradation	4	–	–	1
Energy use	2	4	–	1
GHG emissions	1	2	1	1
Visual amenity	–	2	–	2
EM and compliance	–	–	–	8
Total	151	56	9	27

models (self-regulation, government regulation and co-regulation) and any other 'wish list' items with regard to RER.

The interview research followed Kvale and Brinkmann's (2009) recommended systematic, seven-step progression to ensure that it lives up to scientific criteria, taking into account the ethical aspects of the investigation: (1) thematising, (2) designing, (3) interviewing, (4) transcribing, (5) analysing, (6) verifying, and (7) reporting. A total of thirty six 60–90 minute face-to-face interviews (cases) were conducted with 41 people (some interviews involved two or more interviewees) at senior or middle-management levels from 28 organisations across Australia, of which 16 (24 interviews) were rail organisations and 12 (12 interviews) were government organisations. The person/persons interviewed was/were recommended as the most knowledgeable within that organisation on the subject of environmental regulations pertaining to rail. The transcribed interviews were analysed by coding of meaning through categorisation, which was facilitated by NVIVO software. The results obtained are extensive and rich presenting a challenge to concise reporting. Selected key findings are set out below to give readers a flavour of the qualitative research undertaken (for full results, see von der Heidt, Ryan, Charles, Collier, & Hughes, 2009).

Views on effectiveness of current regime

The need for improved RER was mentioned by just over half (52%) of the participants in the 36 interviews (cases). Indeed, it was strongly advocated by rail track owners/operators (seven cases), government environmental regulators (five cases), other rail (four cases) and rail operators (three cases). Both environmental and transport government regulators and agencies expressed some indecision as to the exact nature of the regulatory problems experienced by rail. Within five of the six stakeholder groups, at least two interviewees indicated that there was no need for improving the present regime.

Five key areas of strength of existing regulation were described by participants, these being: (1) some good working relationships between rail and environmental regulators and between some environmental and transport regulators; (2) competence of regulators; (3) good regulatory tools; (4) better environmental outcomes; and (5) a more

holistic transport perspective. On the other hand, 18 problem areas or weaknesses were identified by interviewees. Table 3 presents a ranked list of the top 10 issues in terms of the number of interview cases and the total number of references mentioning each weakness.

Table 3: Weaknesses and contextual problems with rail environmental regulation (von der Heidt et al., 2009)

	Weakness	Number of cases referring to weakness (out of 36)	Number of total references
1	Different standards for each state	25	64
2	Poor regulation of noise	16	28
3	Lack of understanding between rail and regulators	15	29
4	Severity of legislation	14	33
5	Lack of long-term infrastructure planning	14	23
6	Inequitable treatment of road vs. rail	13	25
7	Lack of regulatory rigour	13	22
8	Lack of industry competence	11	30
9	Excessive cost to industry	9	23
10	Poor interagency cooperation	9	17

Preferred rail environmental regulatory model

Some of the notable views expressed by participants with regard to each of the three main forms of regulation – self-regulation, co-regulation and government regulation – are as follows.

Self-regulation: A range of self-regulatory initiatives are currently practised by the rail industry, which reflects the view that the industry is probably best placed to manage its own impact on the environment; yet it needs to put in place EMS that effectively manage risk and meet State-based legislation. However, there is also a view that the environmental regulatory regime is beyond self-regulation.

Overall, codes of practice (COP) or guides to leading practice as a form of self-regulation were generally viewed favourably by government and rail organisations. However, half the participants (18–12 rail and six government) expressed misgivings about self-regulation in general, and COPs in particular. As set out below, there was a variety of reasons for this perception, such as lack of market drivers to correct third party effects, difficulty in reaching agreement on standards, poor implementation, legal implications, lack of currency, and fear of inoperably high standards.

A wide range of considerations for improving industry self-regulation, including COPs and industry forums were volunteered by rail and government participants – level of standards to be applied (high or low), leadership (industry or government), national application, extent of representation, level of detail and implementation issues.

Co-regulation: Most participants were aware of the basic concept of co-regulation as regulation involving some degree of self-regulation, with government providing some measure of oversight. At this basic level, the meaning of co-regulation appears to have been understood in a similar way by rail and government participants, unlike the initial findings on co-regulation reported in the NTC – National Transport Commission with Booz&Co's (2009c) rail safety regulation regulatory impact statement. Some participants, however, struggled to categorise a particular regulatory initiative as either co-regulatory or government regulation. A government participant suggested that, regardless of whether the regulation is classified as self- or co-regulatory, there will always be some overarching legislation as a fall-back. These findings suggest that any differences are more likely to be due to definitional issues than to differences between the groups.

A significant finding was that the majority of participants (26 out 36 cases or 72%) stated that their preferred model of RER was co-regulation. A breakdown of these cases provided in Figure 2 shows that support for co-regulation can be found across all stakeholder groups and jurisdictions. This suggests that any improvement of RER involving all parties is likely to succeed.

Four key reasons were given for favouring co-regulation, these being that it: (1) promotes better understanding between rail and regulator; (2) represents a middle-ground between self-regulation and solely government regulation; (3) permits more flexibility; and (4) is appropriate given the present degree of maturity of industry and industry structure.

More than half of the participants (19 cases) – mostly rail and state environmental government departments – could name or describe examples of current co-regulatory efforts. A range of examples were cited by participants, including forums (e.g., Rail Industry Environment Committee), guidelines (e.g., Interim Guidelines on the Abatement of Noise from Rail Infrastructure), state planning policies, conferences, and close working relationships between the individual rail organisation and the regulators.

Participants offered a range of views regarding how to address the problems with some of the current co-regulatory efforts and improve co-regulation of rail's environmental impacts in general. One group of suggestions related to the characteristics of appropriate co-regulatory forums, such as representation, scope and leadership. Another set of suggestions considered the values inherent in co-regulation and how rail could better demonstrate its worthiness as a partner in co-regulation.

Government regulation: Five government and rail participants spoke out in favour of government-led rail environmental regulatory change. On the other hand, four rail participants rejected the idea. They pointed to the lack of government

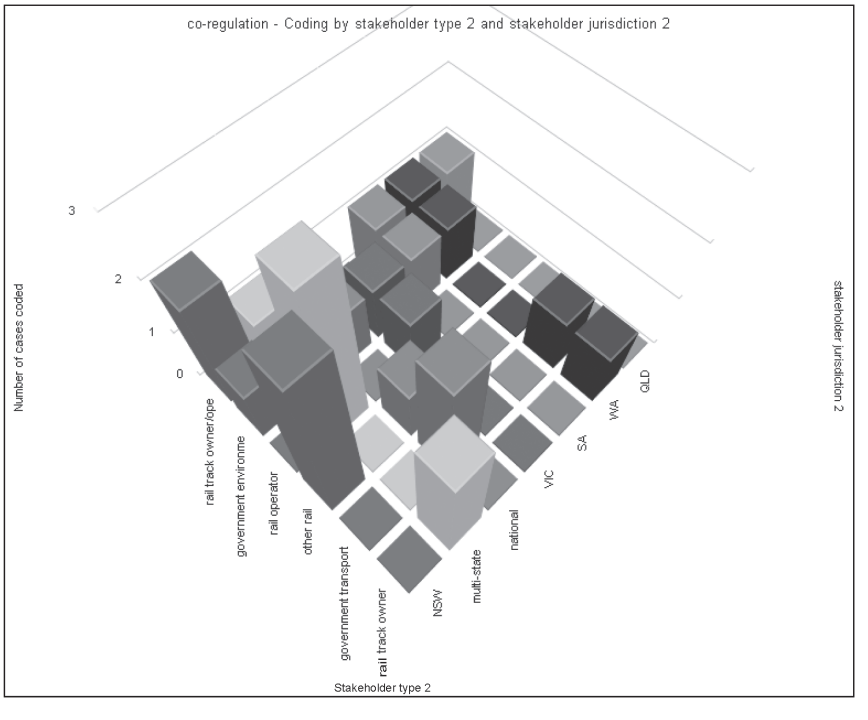

Figure 2: Pro co-regulation cases – By stakeholder type and jurisdiction (von der Heidt et al., 2009)

proactiveness and understanding of the rail industry, as well as reduced opportunities for rail involvement in regulation.

Participants were asked which level of government – state, federal or both – should drive rail environmental regulatory change. The majority of participants who responded to this question preferred government-led rail environmental regulatory reform at the national level. Some participants preferred a combined State/Local and Commonwealth government approach. Several interviewees were more in favour of State-level regulation. Opinions expressed by rail tend to have resulted from disappointing experiences with national approaches. State government participants also tended to be pro State-based regulation. Hence, the continuation with regulation at the State-level appears to be more pragmatic, while national regulation is more idealistic.

A Commonwealth participant suggested that any regulatory reform is likely to proceed incrementally, will need to pass cost-benefit analysis, and will need to involve Federal and State governments. The comments by participants also indicated that the process of bringing a public case for regulatory reform (e.g., via a regulator or State/Federal Minister) needs to be better understood by industry and State governments.

Wish list for rail environmental regulatory reform

When asked to outline their wish list for improving RER, the participants identified 12 main types of suggestions, which complement the suggestions made in relation to the preferred regulatory model described in the previous section. Table 4 presents a ranked list of wish list items in terms of the number of interview cases and the total number of references mentioning each item. Notable is that some wish list items are to do more with the transportation context than with RER. For instance, half of the participants wished for a more long-term and national view of all transport modes, which was the subject of a recent NTC study into improving the co-modal supply chain (NTC – National Transport Commission and Booz&Co, 2009a). For further insight into the wishes for improvement, the reader is referred to the final research report (von der Heidt et al., 2009).

Table 4: Wish list for rail environmental regulatory reform (von der Heidt et al., 2009)

	Wish list item	Number of referring cases	Number of total references
1	More holistic approach to transportation	16	40
2	More industry competence	14	35
3	More standardisation	14	20
4	More rigorous regulation	10	14
5	Better noise regulations	8	14
6	Simplification of regulation	8	13
7	More regulatory flexibility	6	8
8	Better working relationships between rail and regulator	6	7
9	Better horizontal working relationships between regulators	5	8
10	Better vertical working relationships between regulators	2	4
11	Better cost-benefit analysis of regulation	5	7
12	Better resourced regulators	3	4
13	Extension of exemptions for rail	2	3

Evaluating the mixed method RER study

This second part of the paper shows how the research project described above 'fits' various mixed method classifications and designs, as well as accepted guidelines for conducting and reporting mixed methods research.

Classifying mixed method designs

While no taxonomy can completely capture the degree of variation which occurs in 'real world' research (Bazeley, 2009), it is possible to characterise the RER study within two classification schemes. One is the organising idea of an objectivist to subjectivist continuum with hard positivism at one end and constructionism at the other (Hanson & Grimmer, 2005). In between is the soft-positivist, pragmatist research, in which most mixed research is carried out (Teddlie & Tashakkori, 2009). Table 5 illustrates these three main points of the continuum with reference to ontology, epistemology and research purpose.

Further, an approximate position for each of the three research phases of the RER study on the continuum is attempted in Table 5. As shown, the first project phase (the case for change) adopted a 'softer' version of positivism, i.e., objective reality exists but epistemologically the techniques used produce uncertain understandings. Although not conventionally quantitative, the second phase (the inventory) was dominated by a 'harder' positivist ontology. An objective reality regarding the quantity and distribution of RER was inferred with knowledgable degrees of certainty. A qualitative style of research, in which there is a concentration on understanding and interpretation, was undertaken for the third project phase (stakeholder views). With its relativist ontology (each person has his or her own identity) and rejection of objectivity, this methodology is best described as constructionism (Carson, Gilmore, Perry, & Gronhaug, 2001). While each phase works within the pragmatist paradigm, e.g., 'fit-for-purpose', the tendencies (indicated by arrows) in phase 2 (the inventory) to numeric data and in phase 3 (stakeholder views) to narrative data are notable.

A second organising scheme is Leech and Onwuegbuzie's (2009) three-dimensional typology of mixed methods research designs. It conceptualises mixed research designs as a function

Table 5: A mixed method continuum and position of RER study

	Objectivist	In-between, hybrid	Subjectivist
Ontology	Objective reality to be found	Objective reality exists, but understanding is uncertain	Nominalist, relativist (each person has own understanding)
Epistemology	Positivist	Soft-positivist, pragmatist	Anti-positivist (knowledge is contested and provisional); constructivist
Methods	Quantitative, objectively-correct, numerical data	Probabilistic but ultimately uncertain outcomes, e.g., case study	Qualitative, subjective, narrative data, e.g., in-depth interviews,
Research purpose	To describe some part of reality with certainty	Gain insight and describe complexity	Understanding of an individual viewpoint may yield lessons for others
Logic	Hypothetico-deductive	Both inductive and hypothetico-deductive	Inductive
RER study phase	2 → The inventory (regulatory mapping and quantification)	1 The case for change (literature review, pilot case studies)	← 3 Stakeholder view (in-depth interviewing of multiple stakeholders and analysis)

Adapted from Burrell and Morgan, 1979; Hanson and Grimmer, 2005; Teddlie and Tashakkori, 2009.

of (1) level of mixing (partially mixed versus fully mixed), (2) time orientation (concurrent versus sequential), and (3) emphasis of approaches (equal status or dominant status). Of the eight mixed research designs resulting from these three dimensions, the RER study may be classified as 'partially mixed sequential dominant status design' (P4):

- Mixing occurred at the research objective and question, sampling design and interpretation stages. However, data collection and analysis was undertaken separately for each phase.
- The research phases were implemented sequentially.
- The first, second and third research phases were progressively important, with the latter dominating. Qualitative approaches were emphasised, whereby quantification was undertaken to the extent possible.

The corresponding notation – drawing on Morse's (1991) notation for mixed methods research – for the RER study is qual→quan→QUAL, whereby capital letters denote priority and the '→' sign represents a sequential relationship.

As mentioned by Teddlie and Tashakkori (2003), there is merit in using mixed method typologies because they: (a) help to provide more credibility to the social sciences by providing examples of research designs that are markedly different to monomethod designs; (b) help to advance a common language for the mixed methods field; (c) provide direction and guidance for researchers to design their mixed methods studies; and (d) can be used to enhance the instruction of mixed methods research courses. This paper aims to further these objectives by demonstrating – post hoc – a mixed method typology in use within a new context – sustainability issues in management.

Evaluating mixed method research designs and reporting

While mixed method designs have conceptualized in a myriad of ways, until recently the field lacked coherent information on how to conduct, report and evaluate mixed research studies. With their comprehensive 'Guidelines for conducting and reporting mixed research in the field of counseling and beyond', Leech and Onwuegbuzie (2010) have filled this gap. The authors' guidelines or reporting standards assist researchers undertake and report mixed research, which is *warranted* (sufficient evidence is document to justify findings and inferences) and *transparent* (the research process is explicated). The Appendix to Leech and Onwuegbuzie's paper itemises the 43 guidelines. In short, the guidelines cover each of the 13 research steps within the three major mixed method research stages: (A) *Formulation* – (1) literature review, (2) goal of the study, (3) research objective, (4) rationale for mixing and (5) research question; (B) *Planning* – (6) sampling design and (7) research design; (C) *Implementation* – (8) data collection, (9) data analysis, (10) data validation, (11) data interpretation, (12) report writing and (13) reformulation of research question.

In order to determine whether the mixed method RER study met the standards described by Leech and Onwuegbuzie (2010), a post-hoc assessment of the study was undertaken. Table 6 details how research was conducted and reported for each of the three RER study phases (case for change, inventory and stakeholder views) in relation to the guidelines for each of the 13 research steps in conducting and reporting mixed research. Given the 'partially mixed sequential dominant status design' of the study, as explained earlier, two mixed research steps are 'shared' by the three research phases. For instance, the rationale for mixing research (mixed research step 5; Guideline no. 1.3.2) in the study was two-fold:

1. Participant enrichment: To optimise the sample by studying the RER issue through secondary sources (academic literature, rail industry documents, government documents) and, in particular, primary sources (stakeholder views) across multiple study phases.
2. Significance enhancement: To enhance the interpretation of findings by augmenting qualitative analysis (pilot case study, literature

Table 6: Applying Leech and Onwuegbuzie (2010) mixed research guidelines to RER study

Guideline for mixed research step	Phase 1: Case for change	Phase 2: Inventory	Phase 3: Stakeholder views
Research formulation stage			
1. Review related literature	Initial meta research synthesis of selected rail industry documents and published academic work.	Meta research synthesis of all available published and unpublished documents on RER from (i) rail industry and (ii) industry at state and federal levels	Recap of in-depth interviewing method.
2. Specify goal of study	Start to understand complex RER phenomena. Examine the past and identify RER issues. Scope the research to be conducted in Phase 2.	Add to RER knowledge base by compiling a first inventory of all state and federal environmental regulation in Australian rail transport. Deepen understanding of complex phenomena. Generate new ideas from the researcher perspective. Further scope the research to be conducted in Phase 3.	Understand complex RER phenomena from viewpoint of expert individuals in key stakeholder groups. Test researchers' ideas. Generate new ideas (from stakeholder perspective).
3. Specify the research objective	Exploration	Description and explanation	Explanation and exploration
4. Determine the research question	To determine whether an initial case be made and on which basis.	To inventory all RER at state and federal level for each environmental area. To explain conceptually how RER currently works and identify areas for improvement.	To seek empirical explanations from subject experts on their typical experiences with current RER (e.g., strengths and weaknesses, problems and opportunities) To explore with the interviewee options for improving RER, including the most appropriate model for environmental regulation of rail (self-, government- or co-regulation).
5. Provide a rationale for mixing	Participant enrichment: To optimise the sample by studying the RER issue through secondary sources (academic literature, rail industry documents, government documents) and primary sources (stakeholder views). Approval to undertake the interview study was obtained from the University's Human Research Ethics Committee. Significance enhancement: To enhance the interpretation of findings by augmenting qualitative analysis (pilot case study, literature review) with quantitative analysis (inventory).		

Research planning stage

6. Specify the sampling design	Eight pilot case studies of rail organisations with RER issues. Generalisation by case-to-case transfer.	Five national sources (four government and 1 rail) and 18 state sources (eight government and 10 rail) in relation to 16 environmental issues. Analytic and descriptive statistical generalisation.	36 interviews with 41 senior environmental staff from 16 rail and 12 government (federal and state) organisations. Analytic and descriptive statistical generalisation.
7. Specify the research design in terms of (a) mixing, (b) timing and (c) emphasis of approaches	Partially mixed sequential dominant status design 1. Level of mixing: Partial. Mixing occurred at the research objective and question, sampling design and interpretation stages. However, data collection and analysis was undertaken separately for each phase. 2. Time orientation: The research phases were implemented sequentially. 3. Emphasis of approach: The first, second and third research phases were progressively important, with the latter dominating. Qualitative approaches were emphasised, whereby quantification was undertaken to the extent possible.		

Research implementation stage

8. Specify data collection strategies	Mixture of in-depth and breadth interviewing for conducted over 3 months.	Mixture of numeric and non-numeric documents, internal and published. Data was collected over 3 months. It was checked for currency, completeness and rigour.	Mixture of in-depth and breadth interviewing using semi-structure questionnaire instrument with open-ended questions. Interviews were conducted face-to-face over approx. 1 hour. Interview period was 2 months. Kvale and Brinkmann's (2009) seven step process for interviewing followed, including thematising, designing, interviewing and transcription.
9. Specify the data analysis process	Interview data was compiled as a case study by researcher. A variety of sources and issues were highlighted and linked to the existing knowledge base. RER issues highlighted through force-field analysis based on literature and case study data.	Data was reduced, tabulated and quantified in terms of the dimensions of interest (16 environmental areas, federal and state jurisdictions, regulation type).	Transcribed interview data was analysed in NVIVO. Coding of and condensation of meaning was undertaken by researcher using a coding template based on themes/ subthemes relating the research objectives. Data was reduced and displayed in tabulated and graphical form for the themes.
10. Validate the data	All case studies were check by the interviewee subsequent to the interview, providing proof of validity.	Draft tabulations were sent to sources for validation. Data from different sources pertaining to the same RER were cross-checked.	Research procedures were transparent. Researchers continually checked, questioned and theoretically interpreted the findings throughout the investigation. All interview transcripts were checked by interviewees subsequent to the interview, providing proof of validity.

(*Continued*)

TABLE 6: CONTINUED

Guideline for mixed research step	Phase 1: Case for change	Phase 2: Inventory	Phase 3: Stakeholder views
11. Interpret quantitative and qualitative data in terms of significance	Design quality was assured by analytic adequacy. (The case study techniques were appropriate for the research question.) Interpretive consistency was assured through conceptual consistency. Case studies were illustratory, so interpretive agreement was not pursued.	Design quality was assured by analytic adequacy. (The data reduction and counting were appropriate for the research question.) Interpretive consistency was assured through conceptual consistency and interpretive agreement (across participants). Given the comprehensiveness of the data, analytical generalisations could be made.	Design quality was assured by analytic adequacy. (The quantitative and qualitative techniques were appropriate for the research question.) Analytical generalisations were made based on large number and representativeness in terms of jurisdiction and stakeholder group of the interview sample. Interpretive consistency was assured through conceptual consistency and interpretive agreement (across participants).
12. Communicate the results accurately and completely, including the practical significance for policy	Findings were communicated in an initial expose of issues, an issues paper (von der Heidt et al., 2008a).	Findings were communicated accurately and comprehensively in an inventory report (von der Heidt et al., 2008b). Data was presented as an inventory matrix of RER categorised by dimensions of interest. A detailed description of key findings for each environmental issue was also presented. The practical significance of the study was highlighted and limitations of the study were outlined.	Findings were communicated accurately and comprehensively in a stakeholder views report (von der Heidt et al., 2009). Data was contextualised and presented visually and numerically. Quotes were carefully chosen.) All ethical considerations were addressed. The practical significance for policy was clearly stated in terms of the research purpose. Limitations of the study were outlined.
13. Reformulate the research objective including recommendations for further research	Further research recommendations (e.g., Phase 3) were made.	Interim recommendations to address the RER issues identified were highlighted. For instance the opportunity for more co-regulation is an idea explored further in Phase 3. Further research suggestions (incl. Phase 3) were made.	Recommendations for policy action and for further research were developed. These were presented to stakeholders at a workshop and a conference.

review) with quantitative analysis (inventory) across multiple study phases.

The exercise of relating the RER study to the guidelines post-hoc is important, because it demonstrates that the study met the standards required of a genuine mixed method study across all 13 mixed research steps (from literature review to reformulating the research objective), namely as being warranted and transparent. It shows that the RER study did represent a rigorous, integrative, flexible and holistic approach in mixed research design and implementation, as called for by Leech and Onwuegbuzie (2010), despite the added challenge of a multi-phase design.

This analysis of the RER study also provides some post-hoc empirical validation of the mixed research guidelines. The 'success' or impact of the RER study is evidenced in terms of achieving its deliverables – three major peer-reviewed reports (von der Heidt et al., 2008a, 2008b, 2009) and direct input into informing and influencing RER policy through two invited presentations at industry and regulator workshops (von der Heidt, 2009a, 2009b). In addition, based on the results of the RER study, rail industry funding has recently been received for a further 1-year CRC project to quantify the costs to industry of RER.

Conclusion

With limited prior data in relation to the phenomenon of existing RER and possibilities for reform, the research problem initially faced by the research team was complex and ill-defined. This paper has discussed how a partially mixed sequential dominant status design was used to address the research objectives. Applying the guidelines for conducting and reporting mixed research post-hoc highlighted the integrated mixed research design of the RER study. This shows that it is possible to move beyond the quantitative-qualitative divide in mixed methods toward more integrated designs, as called for by leading mixed method researchers (e.g., Cameron, 2008; Leech & Onwuegbuzie, 2009).

The paper also hoped to show that the chosen design was not just 'fit-for-purpose', but also up to mixed research standards. The RER study delivered quantitative and qualitative outcomes for the spectrum of regulatory options (self-regulation, co-regulation, government regulation), enhancing the significance and interpretation of the findings. Further, it represented the range of stakeholder types (rail and government at both state and national levels) with an interest in the issue across all three phases, fulfilling the participant enrichment rationale of mixed methods.

The picture of RER in Australia is now more complete. The outcomes of each of the three phases go toward developing a case for rail environmental regulatory reform. Assuming the results are properly communicated, they will inform the case for RER reform and provide useful policy direction to industry and government decisions. They will assist the rail industry in strategically managing not only its environmental impacts but also its stakeholder relationships with regulators and the public, which is critical to business success (Donaldson & Preston, 1995; Freeman, 1984).

While each method produced its own unique insights, it is notable that all three research phases point to the opportunity for more rail environmental co-regulation. Government regulation tends to dominate the regulatory landscape, especially in the field of environmental regulation (where regulation exists at local, state and federal levels). Yet there appears to be considerable opportunity for organisations and industries to improve self-regulation and for industries and government to coordinate regulatory initiatives. Such self- and co-regulation initiatives are likely to more effective drivers of regulatory harmonisation and leading practice in industry than multi-jurisdictional government regulation (Eisner, 2004). The incentive, here, is for industry to pre-empt regulatory change that could manifest itself in a potentially unpalatable form, and at the same time set the basis for a future regulatory response that has widespread industry and regulator acceptance, thereby ensuring high levels of compliance.

The RER study reported here was a first mixed research study in the field of environmental regulation, a topic of growing importance in managing for sustainability. Given the significance and complexity of the challenge to reform environmental regulation for important infrastructure, further mixed methods research will be required. In a future project, quantitative methods will be used to quantify the cost to business of complying with environmental regulation. This data could be combined with expert interviews (qualitative methods) to distinguish policy-efficient from policy-inefficient regulatory burdens and associated costs. In this way, the research results could feed in to a cost–benefit analysis of regulatory reform and a possible regulatory impact statement for a single, national rail environmental framework, as has recently been proposed by the NTC for rail safety and investigation regulation.

To conclude, thoughtfully created mixed method designs are particularly appropriate when researchers face complex, under-researched problems, such as those experienced by the Australian rail industry with regard to environmental regulation. It is hoped that this paper will contribute to the discourse on adopting mixed research studies in the management field, notably in the important area of sustainability within an industry context.

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