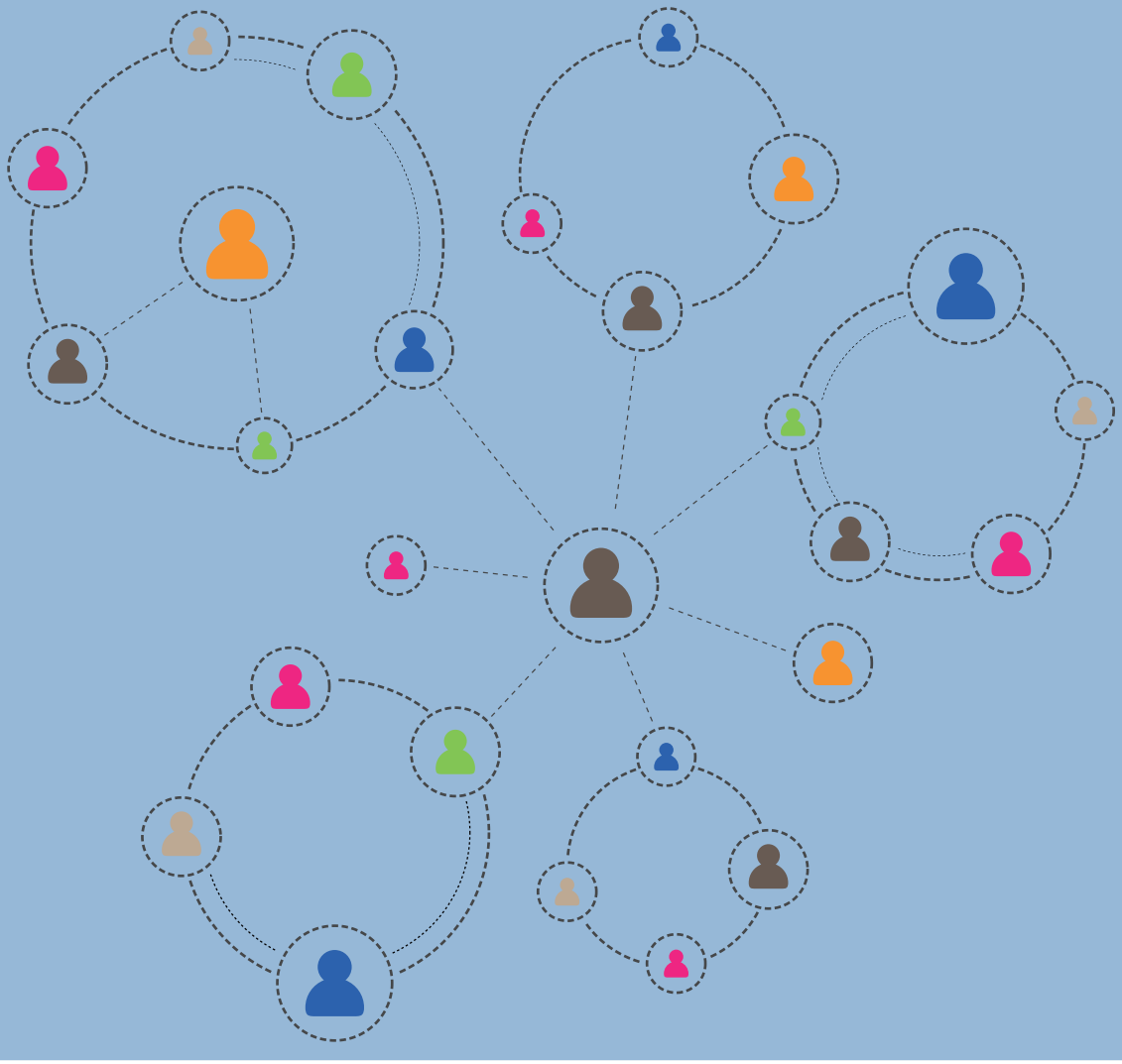
Behavioural Insights and Organisations

FOSTERING SAFETY CULTURE



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BETTER POLICIES FOR BETTER LIVES

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Foreword

For over a decade, policy makers around the world have used behavioural insights (BI) to understand how human behaviour influences policy outcomes. The majority of these applications have been concerned with improving policy implementation and changing individual behaviour; however, many policy areas are also affected by the behaviour of organisations. Can policy makers use BI to change the behaviour of organisations to improve the outcomes of policies and regulations, and promote good governance overall?

This report brings together work on applying BI to foster a "safety culture" in regulators and regulated entities in the energy sector and is intended to serve as a reference for future safety culture research, a field in which BI has been underutilised. The data presented in this report is grounded in an Industrial-Organisational Psychology model that suggests organisations can be influenced through the individuals within them.

The report assembles several pieces of evidence on safety culture conducted since 2017 and led by the OECD Network of Economic Regulators (NER), including experiments with regulators from Canada, Ireland, Mexico and Oman. The conclusions of that work – including the initial comparative results of the safety culture experiments – were presented in the 2019 OECD publication *Delivering Better Policies Through Behavioural Insights: New Approaches.* This report expands upon those results by presenting more detailed country-level data.

While there is no concise internationally agreed upon definition of safety culture, at its core, it is about the organisation's values, beliefs, norms, practices, competencies and behaviours related to safety. Regulators have found clear evidence that many high-profile incidents have occurred – at least in part – due to poor organisational behaviour, including poor safety culture. Regulators have a role to play in advancing safety culture both in their own organisation and in the regulated entities they oversee. This includes understanding organisational behaviour and safety culture, as well as the behavioural barriers and opportunities for changing elements of safety culture.

The research and frontier experiments underlying the report demonstrate the value of regulators exploring new, behaviourally informed strategies to address safety culture. The variation in responses within and among countries highlights the importance of using tailored applications of BI concepts and methodology. The guidance chapter that begins this report highlights lessons learned using each of the behavioural insights tested in the context of safety culture to support policy makers in tailoring their approaches in the future.

This report is part of the OECD work programme on embedding behavioural insights into regulatory frameworks and their delivery, led by the NER and the OECD Regulatory Policy Committee (RPC), with the support of the Regulatory Policy Division of the OECD Directorate of Public Governance. The Directorate's mission is to help government at all levels design and implement strategic, evidence-based and innovative policies that support sustainable economic and social development.

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The overall report was prepared by James Drummond and Anna Pietikainen, under the direction and support of Marcos Bonturi, Director, and Nick Malyshev, Head of the Regulatory Policy Division, Public Governance Directorate. The work underlying the report was originally begun by Filippo Cavassini and Faisal Naru, with contributions from Shelly Hsieh. Jennifer Stein edited and prepared the report for publication, and editorial support was provided by Andrea Uhrhammer.

The Secretariat worked with a team of behavioural scientists who designed the experiments and drafted various chapters and sections (see below). An academic panel of Dr. John Beshears, Harvard University, Dr. Tom Reader, London School of Economics, and Dr. Severine Trouassaert. London School of Economics and Oxford University also provided support and feedback throughout the project.

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The Secretariat would like to acknowledge the contributors to each chapter of this report:

- Overall experimental design was created and implemented by Mary MacLennan, behavioural science consultant and former member of the Impact and Innovation Unit, Canada, supported by Dr Morgan Tear, Research Fellow, London School of Economics and BehaviourWorks Australia at Monash University and Dr Tom Reader, London School of Economics, with input and support from Faisal Naru and Filippo Cavassini. Phase 2 experimental design was created and implemented by Daniel Shephard, PhD Candidate, Colombia University and former member of the Social and Behavioural Sciences Team, United States, building on the initial experimental design and in co-ordination with Mary MacLennan, with inputs and support from Faisal Naru and Filippo Cavassini.
- Chapter 1 (overview) was written by James Drummond and Daniel Shephard, with inputs from Anna Pietikainen, Mary MacLennan and Morgan Tear. A preliminary version was shared with project partners in November 2019, and with NER delegates in February 2020.
- Chapter 2 (theoretical background) was written by Lori Foster, Professor of Psychology, North Carolina State University, Head of Behavioural Science, Pymetrics, and former member of the White House Social and Behavioural Team, in support of the EC-OECD Seminar Series on Designing Better Economic Development Policies for Regions and Cities, Seminar on *Behavioural*

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- Chapter 3 (applying BI to safety culture) was written by Mary MacLennan, with inputs from Faisal Naru, Filippo Cavassini, Shelly Hsieh, Anna Pietikainen and Morgan Tear. A preliminary version was discussed with the NER delegates in Paris on 6 November 2017.
- Chapter 4 (results) was written by Daniel Shephard and Morgan Tear, with inputs by James Drummond and Mary MacLennan. Draft of the results and background work were discussed with NER delegates, including 26 November 2018 (Phase 1 comparative results and Phase 2 scoping and design) and 16 April 2019 (Phase 1 lessons learned and Phase 2 results).
- Chapter 5 (case studies) was prepared by Filippo Cavassini, Shelly Hsieh and Anna Pietikainen based on inputs from ASEA, CRU and AER. A preliminary version was discussed with the NER delegates in Paris on 9 April 2018.

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Abbreviations and acronyms

ABCD	Attention, Belief Formation, Choice, and Determination
AER	Authority for Electricity Regulation, Oman
ASEA	Agency for Safety, Energy and Environment (*Agencia de Seguridad, Energía y Ambiente*), Mexico
CER	Canada Energy Regulator, Canada
CRU	Commission for the Regulation of Utilities, Ireland
BASIC	Behaviour, Analysis, Strategies, Intervention, and Change
BI	Behavioural Insights
I-O	Industrial-Organisational Psychology
OECD	Organisation for Economic Co-operation and Development
NER	Network of Economic Regulators
RCT	Randomised Controlled Trial
REC	Registered Electrical Contractors
RGI	Registered Gas Installers
SSB	Safety Supervisory Bodies
TRB	Transportation Research Board

Executive summary

Human behaviour can be a mystery. Policy makers often assume that humans make “rational” decisions and build policy based on this model. However, social context and behavioural biases often influence people’s abilities to act rationally.

Recognising this, policy makers around the world are now turning to the field of behavioural insights (BI) for a clear methodology that generates evidence on how people actually behave to enhance the way policy is designed and delivered.

It is within this context that the OECD began frontier work on the application of BI to changing the behaviour of organisations, with a focus on fostering elements of a culture of safety in the energy sector. This work was conducted with energy regulators from four countries – Canada, Ireland, Mexico and Oman.

From individuals to organisations: The impact of organisational behaviour on public policy and regulation

Most applications of BI so far have focused on the individual and on solving problems related to implementing public policies. However, for many policy problems – especially those related to enforcement and compliance with regulations – addressing the behaviour of organisations is also a key area of interest.

As the field of BI evolves to tackle more complex policy issues, the widespread perception is that for BI to have a greater impact, it can and should go beyond the study of individual-level decision processes. Governments around the world are turning their attention to meso- and macro-level applications of BI aimed at affecting group and organisational behaviour.

At first glance, applying BI to organisations seems different than applying it to individuals. However, research presented in this publication demonstrates that, although the locus of decision making is different in organisations, choice making is still fundamentally the same in many situations. Changing the behaviour of organisations through the individuals within them thus presents a clear opportunity for expanding the use of BI.

Fostering elements of safety culture in the energy sector through behavioural insights

Despite the role of safety systems and risk management for policy makers around the world, safety culture and the behaviours that drive it are relatively underexplored. In the energy sector, regulators found clear evidence that many high-profile incidents have occurred due – at least in part – to poor organisational behaviour, including poor safety culture. These include major disasters such as the nuclear safety system failure at Fukushima Daiichi plant in 2011, and the BP Deepwater Horizon oil spill in 2010.

The desire to prevent incidents like these strongly supported further research into safety culture from the perspective both of regulators and of regulated entities. The OECD joined with the Canadian Energy Regulator (CER, formerly the National Energy Board of Canada, NEB); the Commission for the Regulation of Utilities (CRU) in Ireland; the Agency for Safety, Energy and Environment (ASEA) in Mexico; and the Authority for Electricity Regulation (AER) in Oman to test the application of BI to safety culture.

The experiments were carried out in two phases and tested 6 insights. Phase 1 tested the effects of various types of safety-related **messengers** (information sources), **feedback** and **social norms** with regulators and large-scale regulated entities in all countries. Phase 2 extended this work to small-scale registered electrical contractors and registered gas installers in Ireland, further testing both the effects of messengers and how to improve inspections through **implementation intentions** (prompting commitment to a plan of action), **primacy** (focus attention on areas by placing them first) and **personalisation** (using information about the recipient).

Some of the key findings are as follows:

- **The perception of the levels of safety culture was lowest amongst front-line workers in regulated entities and regulators**, improving through the middle and senior management chain in regulated entities. This suggests the need to tailor messages to the audience, as a fundamental difference in perception may influence the take-up of the message.
- **Comparative results were mixed, varying by each national perspective and context**. Overall, it was found that messages from someone one step "above" but socially close worked best; some feedback was better than no feedback, though it was not clear what the best type of feedback was; and social norms performed least effectively, except for descriptive norms in Mexico.
- **Entities under newer regulatory schemes and organisations were most influenced** by BI at the small-scale level in Ireland. It was found that inspections could be improved by combining primacy with an implementation intention; personalisation of non-conformity notices improve responsiveness of firms but not of individuals; and trainers were particularly effective messengers in Ireland.

Guidance for policy makers: Towards a toolkit for fostering safety culture

The results from the experiments demonstrate the potential effectiveness of BI as a tool for influencing safety culture, while also highlighting its contextual nature and the need to adapt to each setting. The results and findings point to some suggestions for moving towards more practical tools and guidance to support policy makers in promoting safety culture.

The natural starting point is a toolkit for applying BI in general. The BASIC toolkit, which provides a process for applying BI from start to finish and released by the OECD in 2019, was under development during the course of these experiments and the steps were largely followed. This demonstrated the relevance and applicability of the BASIC methodology to studying safety culture.

The experiments also provided the following lessons that can help adapt BASIC to future work, and position the methodology in a holistic approach to fostering a culture of safety:

1. Use a multi-staged, iterative process when applying BI to safety culture that includes qualitative research, smaller-scale experiments for exploratory work, and, last, field experiments to test concrete results for a higher probability of success.
2. Understand the group you are trying to influence and adapt the behavioural insights accordingly.
3. Apply the six tested insights in a way that is best adapted to the specific context of safety culture.
4. Recognise the limitations of the state of knowledge in this field and its impact, especially given the fact that this is frontier work.
5. Continue research in areas identified by these experiments so that energy regulators and researchers can move forward and expand the collective knowledge of this field.

1 Overview and guidance for policy makers

This chapter provides an overview of the origins, theoretical background and results from online experiments that examined how regulators can foster elements of a culture of safety in the energy sector with the use of behavioural insights. The chapter concludes with guidance on how regulators can apply these lessons to future projects on enhance safety.

Human behaviour can be a mystery. Policy makers often assume that humans make “rational” decisions and build policy based on this model. However, social context and behavioural biases systematically influence people’s abilities to act rationally, and often counter to these models of rational decision making.

The core concepts are easy to relate to: we have limited ability to attend to all aspects of life, our choices are shaped by our context, we often have difficulty making sense of the complex world around us and we have bounded willpower that limits our determination to stick with decisions over time (OECD, 2019[1]). These behavioural issues are increasingly being considered when analysing, designing, implementing and evaluating policies.

Policymakers around the world are turning to the field of behavioural insights (BI) for a clear methodology that generates evidence on how people “actually” behave. The field of BI is fundamentally about analysing policy problems based on lessons derived from the behavioural and social sciences, collecting evidence of which solutions works and which do not, and applying these findings to improving the outcomes of public policy.

A key feature of the BI methodology is its empirical approach, driven by experimentation and piloting. This approach also allows policy makers to experiment and test solutions at smaller scale to determine the best course of action. As a result, governments can test multiple policy solutions with the beneficiaries at once before committing to resources to implementing full policy solutions that may need to be revisited later (OECD, 2019[1]).

This approach has been used around the world to make policies better (OECD, 2017[2]). This publication presents the findings and guidance for policy makers from new research into the application of BI to fostering elements of safety culture in the energy sector. The findings have enhanced the practical understanding of both organisational behaviour of regulated entities, as well as pushed the frontier towards a more frequent integration of the field of BI and safety. This chapter presents an overview of the project, a summary of the key findings, and actionable guidelines for policymakers.

Applying behavioural insights in public policy: from individuals to organisations

Behavioural insights is a powerful tool for understanding human biases in decision making across a number of policy areas and disciplines (see Box 1.1). As BI started to be used more systematically by governments around the world, its effectiveness at addressing policy issues had to be demonstrated. Some governments created “nudge units” within the public administration to demonstrate positive return on investment within a short timeframe. Famously, the UK Government’s Behavioural Insights Team (BIT) – the first such unit – began with a mandate that required them to demonstrate a tenfold return on investment in two years (Halpern, 2015[3]).

A scan of the use of BI by governments, across sectors, shows that most applications have been aimed mostly at correcting individual-level biases in decision-making (OECD, 2017[2]). This has enabled governments to simultaneously impact thousands, or in some cases millions, of people at once.

However, policy problems are not solely confined to problems of individual behaviour – the behaviour of organisations are omnipresent in most sectors of the economy. This is true, for example, for economic regulation that has the purpose of regulating and supervising the behaviour of regulated entities that are organisations, rather than individuals. As the field of BI evolves to tackle more complex policy issues, the widespread perception is that BI can and should go beyond the study of individual-level decision processes for higher impact (OECD, 2018[4]). Governments around the world are starting to study how the field of BI can be broadened to include meso- and macro-level applications aimed at affecting the decisions of groups of people, including organisations.

Box 1.1. The "ABCD" of behavioural insights in public policy

Have you ever missed an important appointment because you had too much to do and forgot? Given up on properly filling out a form because it was too cumbersome and hard to understand? Driven a little above the speed limit because all the other drivers were going fast as well?

These are everyday examples of how context and behavioural biases can influence decision-making.

A better understanding of human behaviour can lead to better policies. Drawing from rigorous research from behavioural economics and the behavioural sciences, behavioural insights (BI) can help public bodies understand why citizens behave as they do and pre-test which policy solutions are the most effective before implementing them at large scale. By integrating BI into policymaking, policymakers can better anticipate the behavioural consequences of policies and ultimately design and deliver more effective policies that can improve the welfare of citizens.

The "ABCD" framework focuses on four key drivers of behavioural policy problems: Attention, Belief Formation, Choice and Determination (see Table 1.1).

Table 1.1. The ABCD framework with examples

The ABCD of behavioural drivers	Sample policy problem	Behavioural strategy	Impact
Attention: people's attention is limited and easily distracted	Patients fail to attend their medical appointments	Send SMS reminders that include the cost of a missed appointment to the health system	25% reduction in missed appointments
Belief formation: people rely on mental shortcuts and often over/under estimate outcomes and probabilities	Residents speed up at sharp turns, resulting in more car crashes	Paint a series of white lines to create the illusion of speeding up so people slow down	36% fewer crashes in 6 months
Choice: People are influenced by the framing and the social as well as situation contexts of choices	Households do not make sufficient efforts for energy efficiency	Send letters to utility customers comparing their electricity consumption to that of neighbours	2.0% reduction in electricity consumption, resulting in a reduction of 450k tonnes of CO2 and USD 75 million in savings
Determination: Even when people make good choices, people's willpower is limited and subject to psychological biases that prevent long-run success	Job seekers are struggling to find work	Create a "commitment pack" that includes meeting with an employment advisor to create an actionable job-hunting plan	23% more job seekers found work

Source: (OECD, 2019[1]), *Tools and Ethics for Applied Behavioural Insights: The BASIC Toolkit*, Paris, https://doi.org/10.1787/9ea76a8f-en.

Impacts of organisational behaviour on public policy and regulation

Discovering how to change organisational behaviour is important for regulatory policy in two key ways. First, economic regulatory authorities[1] act as "market referees" by protecting market neutrality and fostering competition to ensure access to and quality of public utilities (OECD, 2016[5]). This function necessarily means interacting with firms who deliver utilities to consumers. While BI has been applied successfully to improving consumer choices in regulated markets (Lunn, 2014[6]); (OECD, 2016[5])), regulators also have the remit to engage with regulated entities and their behaviour. There is an opportunity to discover behaviourally-informed solutions that can both improve the functioning of firms in regulated sectors, as well as the interaction between the regulator and regulated entities.

Second, there is the possibility of large economic gains from improving the functioning of firms in regulated sectors. It is well-recognised that the organisational culture within firms has a powerful effect on both the performance and long-term success of those entities (Cameron and Quinn, 2011[7]). Commonly, less prominent failures in organisational culture can lead to pervasive economic impacts. (Cialdini, Petrova and Goldstein, 2004[8]) argues that the negative consequences of poor organisational culture reduce not only the health of the organisation but of the people inside them as well. This can lead to poor performance and productivity stemming from a poor reputation, mismatching of employee values leading to absenteeism, low job satisfaction, high turnover, and theft, as well as increased surveillance from both the regulator and management that foster a resistance to control and a negative perception of the entire system. In one estimate, employee theft in the United States alone led to about USD 40 billion in losses annually, which is nearly 10 times the cost of all street crimes including burglary (US Chamber of Commerce, in (Thau, Pitesa and Pillutla, 2014[9]).

Applying BI to organisational behaviour: origins of the safety culture project

At first glance, it may seem as though applying behavioural insights to organisations is different to individuals. However, research consistently argues that while the venue for decisions has changed, choice-making is still fundamentally the same. Research presented in this publication (see Chapter 2) makes the case that organisations are made up of individuals and group decisions are affected by individual input. They are susceptible to many of the cognitive and behavioural tendencies at work that we are influenced by outside of work, although the nature of groups and organisations can alter those tendencies. Organisational literature has highlighted the fact that perceptions about an organisation are strongly related to perceptions of individuals – such as supervisors – in that organisation (Eisenberger et al., 2002[10]). Psychological research on teams has shown similarities with individual psychology and behaviour (Wieber, Thürmer and Gollwitzer, 2012[11]); (Schoemaker, 1993[12]).

Therefore, where groups function similarly to individuals, many of the same behavioural insights could apply. Where groups and organisations function differently than individuals, it will be important to tailor any intervention to the behavioural insights that are unique to them (Sunstein and Hastie, 2014[13]); (2015[14]) that businesses and organisations can be influenced using behavioural insights as has been documented in reviews of their application to public policy (OECD, 2017[2]) and in reviews of the literature on strategy and management (Stingl and Geraldi, 2017[15]); (Gavetti et al., 2012[16]). Sample case studies can be found in Box 1.2.

Box 1.2. Case studies on the application of BI to changing organisational behaviour

As part of the early scoping work on applying BI to organisational behaviour, (Shephard, 2017[17]) produced a series of cases that either directly involve organisations or can inform interventions at an organisational level. Some examples include:

- Social norms: In the United Kingdom, the Chief Medical Officer sent a letter to select general practices notifying them that they were prescribing more antibiotics than 80% of the practices in their NHS Local Area Team. As a result, 73 406 fewer prescriptions were made across 791 intervention practices, compared to the control group of 790 practices. While the letters were sent to individuals, organisational level impacts were noted (Hallsworth et al., 2016[18]).
- Implementation intentions: For groups, the formation of implementation intentions can counteract weaknesses of group dynamics by increasing their likelihood of selecting an optimal decision and decreasing the likelihood of escalating commitment to a failed course of action. (Thürmer, Wieber and Gollwitzer, 2014[19]) demonstrated in a laboratory setting that adding an

implementation intention to a group resulted in that group being more efficient and more likely to choose the best alternative.

- Combining top-down and bottom-up accountability: An RCT in India compared 60 schools in which each teacher was given a camera that students would use to take a time-stamped photo of the teacher and other students at the beginning and end of each day. The teachers' salary was linked to their attendance. This combination of a classic incentive with bottom-up social pressure from students resulted in teacher attendance rates increasing from 58% in control schools to 78% in treatment schools (Duflo and Hanna, 2005[20]).
- Priming identity and ethical salience: In the USA, the Social and Behavioural Sciences Team (2015) worked with the General Services Administration (GSA) to test a change in the online reporting used by vendors to report their sales, which was used to calculate their Industrial Funding Fee paid to the GSA. A signature box was placed at the beginning stating "I promise that the information I am providing is true and accurate". The amount of fees collected from the vendors rose in a single quarter by USD 1.59 million). The effect dissipated in future quarters; however, the initial increase in receipts remains a substantive finding.
- Reference class forecasting: Ample behavioural research has shown how the escalation of commitment, the planning fallacy and over-confidence can lead to decision-making and forecasting errors. (Flyvbjerg, 2006[21]) found that the average inaccuracy in cost forecasting was 44.7% for rail, 33.8% for bridges and tunnels, and 20.4% for roads. Usage of rail was underestimated by 51.4% and 9.5% for roads. Examples using these as "reference cases" demonstrated how forecasting can be at least partially debiased or used as a due diligence process to stop projects with a high likelihood of cost overruns and underperformance before they start.

Source: (Duflo and Hanna, 2005[20]), "Monitoring works: Getting teachers to come to school", NBER Working Papers, No. 11880, National Bureau of Economic Research, www.nber.org/papers/w11880; (Flyvbjerg, 2006[21]), "From Nobel Prize to project management: Getting risks right", Project Management Journal, Vol. 37/3, pp. 5-15, https://www.pmi.org/learning/library/nobel-prize-project-management-risks-2545; (Hallsworth et al., 2016[18]), "Provision of social norm feedback to high prescribers of antibiotics in general practice: A pragmatic national randomised controlled trial", The Lancet, Vol. 387/10029, pp. 1743-1752, http://dx.doi.org/10.1016/S0140-6736(16)00215-4; (Shephard, 2017[17]), "Applying behavioural insights to organisations: global case studies", EC-OECD Seminar Series on Designing better economic development policies for regions and cities, 10 May 2017, Paris, https://www.oecd.org/cfe/regional-policy/Shepard_Applying-Behavioural-Insights-to-Organisations_Case-Studies.pdf; (Social and Behavioral Sciences Team, 2015[22]), Annual Report, Office of the President National Science and Technology Council, Washington, DC.; (Thürmer, Wieber and Gollwitzer, 2014[19]), "A self-regulation perspective on hidden-profile problems: If-then planning to review information improves group decisions", Journal of Behavioral Decision Making, Vol. 28/2, pp. 101-113, http://dx.doi.org/10.1002/bdm.1832.

Fostering elements of safety culture in the energy sector: Overview and key results for Canada, Ireland, Mexico and Oman

The OECD Network of Economic Regulators (NER) brings together over 70 economic and network regulators from across the world that operate in different network sectors, such as communications, energy, transport and water. The NER allows regulatory agencies to share their experiences, challenges and innovative solutions to regulatory policy design and delivery and to enhancing their performance.

In the energy sector, regulators have found clear evidence that many high profile incidents have occurred – at least in part – due to poor organisational behaviour, including safety culture. These include, for instance, the nuclear safety system failure at the Fukushima Daiichi plant in Japan in 2011 (OECD/NEA, 2013[23]), and behavioural and cultural factors that contributed to the BP Deepwater Horizon oil spill in 2010 (Reader and O'Connor, 2014[24]); (Corkindale, 2010[25]). Smaller scale accidents, which are inherently more frequent, can also be partly motivated by poor safety culture. For instance, one study analysed 15 major

petrochemical accidents between 1980 and 2010 noted that poor safety culture contributed to 12 of the 15 accidents (Fleming and Scott, 2012). Major incidents are usually the product of a simple (i.e. minor) decisions or behaviours and system complexity. Safety culture is about changing these simple decisions and behaviours to prevent incidents (both minor and major).

Prevention of incidents like these strongly supported further research into safety culture in regulators and regulated entities. On the one hand, regulators have a role to play in advancing safety culture across the industries that they oversee. This includes a duty to lead the way by understanding their own organisational culture, as well as that of the regulated entities that they oversee. On the other, changing organisation culture requires an understanding of the barriers and opportunities for changing elements of safety culture within regulators and regulated entities (see Chapter 3).

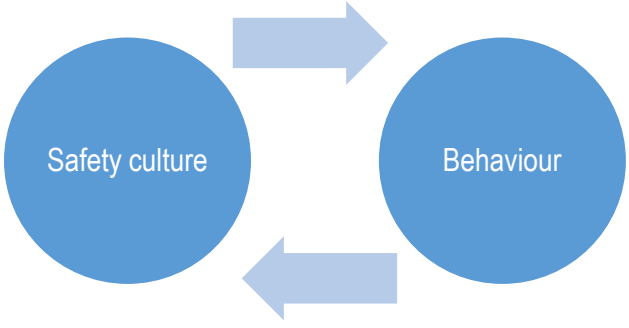
In both cases, regulators may look to behavioural insights as a powerful tool for understanding and enhancing organisational behaviour to foster elements of safety culture in the energy sector. Through the NER, the OECD has been able to develop an extensive knowledge of BI applied to regulatory policy and regulation across a number of sectors and countries (Lunn, 2014[6]); OECD 2016, (OECD, 2017[26]). Within this context, energy regulators from four countries – the Canadian Energy Regulator[2] (CER, formerly the National Energy Board of Canada, NEB), Canada, the Commission for the Regulation of Utilities (CRU), Ireland, the Agency for Safety, Energy and Environment (ASEA), Mexico, and the Authority for Electricity Regulation (AER), Oman – joined together for the first-ever comparative application of BI to safety culture.

Overview of the project

In 2017, the OECD began work with the project partners investigating the application of BI to changing the culture of organisations, with a focus on strengthening a culture of safety in the energy sector. While research notes the lack of a concise internationally agreed upon definition of safety culture in the literature (see Chapter 3), it is noted that – at its core – safety culture is about the organisation's values, beliefs, norms, practices, competencies and behaviours related to safety (TRB, 2016[27]). There is also a clear understanding that safety culture impacts safety performance (Smith, Emma and Wadsworth, 2009[28]).

It is widely acknowledged that regulators have a central role in promoting safety culture. However, a number of reviews and commissions established to investigate accidents have highlighted the importance of the responsibility of the industries in combination with regulators to promote a safety culture, acknowledging limits of regulation and that regulators cannot create a safety culture on their own (TRB, 2016[27]). There are also a number of barriers and enablers to safety culture, which are discussed further in Chapter 3.

Figure 1.1. Theoretical interaction of behaviour and safety culture



More broadly, safety culture is related to BI as behaviours for safety are an essential and visible component of safety culture (OECD, 2019[29]). Safety culture itself is the result of a series of safety innovations over the last 70 years that have focused on standards, compliance frameworks and systems to predict risk.

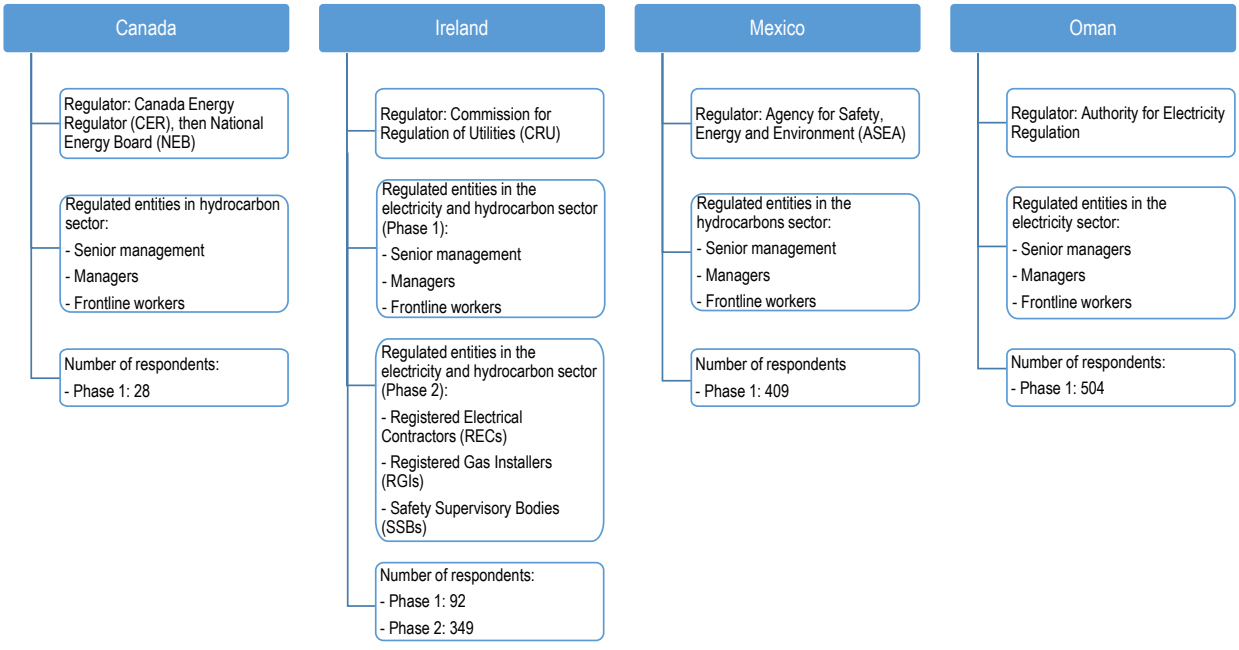
Embedded within these innovations have been behavioural aspects of safety culture, including awareness raising, discussions on safety, clear boundaries for behaviour and required consideration of safety-critical behaviour. Behaviours can also have a feedback loop to affecting culture; that is, as a behaviour becomes an entrenched and visible part of an organisation, it could influence the culture of that organisation as well. In this sense, BI and safety culture could interact as a bi-directional cycle (see Figure 1.1). Context can also be an external influence and impact both safety culture and behaviours.

What was found lacking, however, was the issue of "person centred problems", and research notes that the application of BI is worth considering as possible enablers of safe behaviour and decision making (Krause, Sellers and Horn, 2001[30]). While BI is not a "silver bullet" – or cure-all – that can create safety culture, it can be used in a complementary fashion for improving workplace safety (DeJoy, 2005[31]). Noting this limitation, the intention of this project was to see how BI could amplify efforts to promote safe behaviour via individuals within organisations. The project was implemented in two phases: first a set of comparative online experiments with regulators and regulated entities in all four countries, and second a follow up experiment with registered electrical contractors and gas installers in Ireland. The results are presented in Chapter 4.

Testing BI applied to safety culture in a two-phased approach

This study sought to explore the application of behavioural insights to fostering elements of safety culture through two phases: First, experiments testing the same behavioural insights in Canada, Ireland, Mexico and Oman at the same time amongst regulators and regulated entities in the energy sector and, second, a follow up study in Ireland further testing one behavioural insight from Phase 1 as well as improving inspections reports. A full breakdown of the project partners and participants can be found in Figure 1.2.

Figure 1.2. Overview of project partners and sample participants



Phase 1: Experiments in Canada, Ireland, Mexico and Oman

The first phase brought together energy regulators and regulated entities in Canada, Ireland, Mexico and Oman to test the potential importance of BI to fostering elements of a safety culture. Three key BI principles were tested, based on a review of the literature and qualitative research to understand the specific contexts with regulators and regulated entities:

- Messenger: People process the same information differently depending on who they received it from ((Clark et al., 2013[32]); (Eckel and Gintis, 2010[33]).
- Social benchmarking / feedback: People pay attention to feedback in almost everything they do and often cannot adjust their behaviour without it. Providing a benchmark can reduce mistakes and make the consequences of decisions more salient.
- Social norms: People tend to survey their social and physical environment for attitudinal and behavioural cues and they care deeply about what their neighbours do. This is especially true when their neighbours belong to their same social in-group.

It should be noted that feedback and social norms are subsets of the larger domain of social influences. This domain notes that humans are social creatures and look to the behaviour of others for information on how they themselves should behave (Bicchieri, 2005[34]); (Goldstein, Cialdini and Griskevicius, 2008[35]).

The experiment consisted of an online questionnaire that assessed respondents perceptions of safety culture, presented them with vignettes[3] presenting three scenarios (new guideline regarding Personal Protective Equipment, reports of a bad lost-time injury rate, and a situation where a supervisor asks a worker to carry out a task in an unsafe manner), asked qualitative follow ups, and collected basic unidentifiable demographic data. A complete overview of the methodology for the phase one experiments is published in (OECD, 2019[29]).

Phase 2: Experiments with registered electrical contractors and gas installers in Ireland

The second phase extended this work to small-scale regulated entities in Ireland under the auspices of the Commission for the Regulation of Utilities (CRU). The CRU oversees the Safety Supervisory Bodies (SSBs), which administer the safety schemes for Registered Electrical Contractors (RECs) and Registered Gas Installers (RGIs). These are, respectively, the Safe Electric Register of Electric Contractors (hereafter Safe Electric) and the Register of Gas Installers of Ireland (RGII).

Phase 2 continued to explore some of the findings from Phase 1, particularly the messenger effects that had the strongest effect for Ireland in Phase 1. This was done by looking at messages from a trainer (a high status peer), from the regulator, and from SSBs with whom RECs and RGIs register and whom also mediate messages coming from the regulator. This behavioural insight was chosen because it was the most effect behavioural insight for Ireland in Phase 1.

Phase 2 investigated new areas as well, particularly in regards to applying BI to improving the effectiveness of inspections and the feedback associated with such inspections. The experiments investigated three behavioural insights (in addition to messenger effects) through adjustments made to the forms used to conduct inspections and provide feedback after inspections designed to improve the salience of safety:

- Implementation Intention: prompting the commitment to a plan of action with a specific time
- Primacy: changing the order of inspections to focus attention on areas by placing them first
- Personalisation: the use of specific information about the recipient and their needs

Similar to Phase 1, the survey experiments were carried out through an electronic questionnaire sent out to the regulated entities, staff of the SSB and the staff of CRU. A complete overview of the methodology and results are located in Chapter 4 of this publication.

Summary of the results and lessons learned for Canada, Ireland, Mexico and Oman

The two phases of this study demonstrate that behavioural insights can influence attitudes and behaviours of organisations related to safety culture. This section summarises these results by each phase and provides lessons learned for the project partners that could help inform the development and delivery of regulations in the future.

Full details on the results of both phases of the experiments can be found in Chapter 4.

Phase 1

The first phase analysed the results from two perspectives: a comparative perspective that sought to tie together findings across countries, and a country-by-country perspective highlighting how the behavioural insights worked for each project partner.

Overall, the results reveal interesting insights for each country, and regulatory policy in general. Further research for Canada, Mexico and Oman, like that conducted in Phase 2 in Ireland, would help to better understand the effect of behavioural biases in their given context, and which behavioural solution is best suited in response to achieve desired outcomes.

A key finding from the comparative analysis of the data was on the perception of safety culture. Within regulated entities, frontline workers had the lowest perception of safety while this perception increased as the management level increased. Regulators had the lowest perception of safety of all survey participants. These results make sense given that frontline workers are more likely to witness unsafe activities first hand, and the role of regulators is to be analysing their sector for potential risks. This does not suggest any influence on the capabilities, expectations or actions of regulators or regulated entities, as this was not part of the study and evidence would be needed to support such a claim. What this finding does suggest is the need to understand the audience and how they perceive the issues at hand, which may influence their understanding and alter the way in which messages are delivered and received.

With regards to the three behavioural insights tested, it was difficult to draw conclusions from a comparative perspective as each insight operated differently in each country context. Broadly, it was found that the source of messages mattered, highlighting the need to ensure messages about safety are transmitted through the appropriate channels. Some feedback was overall better than no feedback, but the results were inconclusive as to which type of feedback was best. Finally, social norming was perceived as the least effective across the sample, with the exception of descriptive norms in Mexico.

Detailed findings, as well as suggested focus areas are included in Table 1.2 and OECD (2019[29]).

Table 1.2. Key comparative findings and suggested areas of focus by country

	Messenger	Feedback	Social norms	Perception of safety
Canada	Explore how to deliver consistent messages across all occupational groups, reinforced by regulators or managers. Also explore how messages are affected by entity size (i.e. peers in smaller entities may have great influence).	Investigate making benchmarking data available and relevant for all staff, including front line staff who do not often have access to this information. Feedback for managers was still seen as important, who may have bonuses tied to benchmarks.	Explore further descriptive norm-based approaches that focus on communicating what people actually do to adhere to safety guidelines, which was highlighted by qualitative responses as being potentially useful.	Conduct further research on how safety culture is affected by occupational group and perception of safety.
Ireland	Focus on management messengers and written messages for large-scale entities, as messages coming from direct peers were perceived as	Explore the effectiveness of this approach for entities that are below-average in terms of safety culture, as senior managers and, to a lesser extent, front line staff	Conduct more research on norms, which performed relatively well in the comparative results and additional analysis demonstrated potentially	Adjust approaches and tools based on the perception of safety culture by occupational role in the entity, as senior managers appear to be highly affected

	Messenger	Feedback	Social norms	Perception of safety
	susceptible to being incorrect, with difficult or possibly reluctant delivery that would minimise effects.	appeared highly affected.	positive, albeit insignificant, results for entities with either below- and above-average perceptions of safety.	but managers views appear not be as a highly affected.
Mexico	Consider the effect of pairing clear messages with the descriptive norms approach to reduce as much as possible uncertainty amongst regulated entities.	Investigate further the usefulness of feedback, which performed relatively poorly in the comparative results but sometimes showed promised when viewing results segmented by perception of safety culture.	Utilise the strength of descriptive norms to communicate what people actually do to adhere to safety guidelines, potentially further testing the effects of leveraging on the desire to reduce uncertainty in the workplace.	Explore further how safety culture is affected by senior management, management and frontline staff to determine how best to influence each occupational group as results demonstrated both positive and uncertain outcomes for each group.
Oman	Utilise the strength of message emanating from the regulator and senior management to ensure that regular and consistent messages are being delivered to all occupational groups.	Investigate the ways that feedback can be fully leveraged to promote better outcomes with regulated entities, especially given the relative success of feedback for entities with average or above-average perceptions of safety.	Consider re-testing descriptive norms, including to support other higher performing insights, as norms performed relatively poorly for Oman throughout the study but relatively high scores on uncertainty avoidance may give some hope for positive future outcomes.	Focus pitches based on the entity's safety culture at frontline staff and managers, who showed more susceptibility to responding to these vignettes than did management.

Note: For Canada, due to a small sample size (n=28) and a 6 to 1 response rate by regulators over regulated entities, these results should be seen as indicative and validated by additional research. For Ireland, a larger but still relatively small sample size (n=92) means the results should be interpreted with caution.

Phase 2

Behavioural insights were effective in improving the likelihood that respondents believe safety-related non-conformances would be resolved. More specifically, the use of behavioural insights was effective in the relatively new regulatory scheme for registered gas installers and was effective with organisations (compared to self-employed, individual installers).

Results showed that inspections can be improved by placing areas of more common non-conformance first in the inspection form and combining that primacy with an implementation intention (planning prompt) to designate a specific time to resolve the problem. When sending notices about safety problems ('non-conformances'), the study found that combining personalisation reduced the responsiveness of individual installers while improving the responsiveness of firms. Meanwhile, as was the case with inspections, the use of implementation intentions was effective at increasing the likelihood that respondents believe that safety problems will be addressed.

Finally, it was found that trainers are particularly effective messengers for installers because they share a social community with recipients while also having higher status and more expertise.

Suggested areas of focus include:

- Feedback: Test the use of inspections for the provision of safety related feedback combined.
- Primacy: In both inspections and communications, carefully select the material that appears first as this is most likely to receive the most focus.
- Implementation intentions: Wherever possible, prompt organisations to make explicit, concrete implementation intentions for when, where, and how they will follow through on the desired behaviour. Such implementation intention planning prompts can be included in existing forms and communications to regulated entities.

- Messenger: Explore the use of trainers as messengers among small-scale regulated entities and test the effects through a field experiment.

Guidance for policy makers: Towards a toolkit for fostering safety culture

The following section provides guidance on how regulators can apply behavioural insights to enhance safety. These are presented in the form of action points and implications, informed primarily by the results of Phase 1 and Phase 2 studies alongside the relevant literature. Taken together, this guidance forms the beginning of a "toolkit" on how BI can help foster elements of safety culture in the energy sector.

The results presented in this report point to the contextual nature of the insights gathered. This guidance proposes a series of steps to regulators around the world for applying BI to issues with safety culture that can be adapted to their setting. This comes with a word of caution: more research is needed in each given context to understand what works, and what does not, so that the methods and approaches can be fine-tuned for maximum effectiveness. This guidance provides a beginning that should be updated and amended as new evidence is gathered.

This section offers five lessons learned that provide guidance for policy makers looking to apply BI to safety culture:

1. Utilise a multi-staged process for applying behavioural insights to safety regulation.
2. Understand the group you are trying to influence and adapt the behavioural insights accordingly.
3. Apply and test combinations of the six highlighted behavioural insights principles most effectively.
4. Recognise the limitations of the state of knowledge in this field and its impact, especially given the fact that this is frontier work.
5. Continue research in areas identified by this study so that energy regulators and researchers can move forward and expand the collective knowledge of this sector.

Utilise a multi-staged process for applying behavioural insights

Findings from both phases of research demonstrate the value of regulators exploring new, behaviourally informed strategies to address issues around safety culture. This study found that behavioural insights can be applied to organisations through the people within them. This work highlights both how behavioural insights influence elements of safety culture and how the level of safety culture can influence which behavioural insights are most effective. The varied responses within and between the four countries highlight the importance of testing behaviourally science applications and of avoiding the temptation to apply the same techniques in all cultural contexts.

This work followed a multi-stage blueprint that can inform continued work by regulators to apply behavioural insights to improve safety. By following the four stages, regulators can increase the efficiency and effectiveness of the application of behavioural insights in this sector and others. :

1. Follow a clear methodology that invests time upfront to fully scoping the behavioural problem, such as the BASIC approach (see Box 1.3). This includes the combined use of literature reviews, structured conversations with policy communities such as the NER, and discussions with experts to gain a nuanced understanding of the safety problem, its behavioural drivers, and what behaviourally-informed policy solutions are feasible.
2. Qualitative research is valuable for identifying behavioural barriers and solutions and to reveal differential perspectives between groups that may highlight biases and avenues of potential intervention. Working with researchers in the academic domain and including the participation of regulators and regulated entities is advisable when conducting such research. If different groups of respondents perceive different problems (e.g. regulators and regulated entities), such disagreements may indicate productive areas for applying behavioural insights (e.g. biased

understandings of the frequency of specific safety behaviours that could be corrected through the use of descriptive norms). The use of semi-structured interviews and focus groups that include open-ended questions are useful research tools in this situation.

3. Survey experiments allow regulators to test a menu of behavioural interventions in the context of hypothetical behaviour. This enables lowering costs, conducting more tests, and generating results more quickly. As demonstrated through the two-phases of studies in Ireland, several survey experiments can be done to target new groups and explore behavioural insights in more depth and with new entities. The findings can then help regulators select final insights to test through a subsequent field experiment.
4. Field experiments are effective as a final step, as they can be informed by previous work to increase the probability of their success. These experiments should be designed to measure observed (or reported) behaviour. Whenever possible, it is advisable to use existing administrative data sources to decrease the cost burden and enable continuous testing and improvement using current systems. Ideally, it would only be after the results of such a field experiment that a procedure change or policy change could be made.

Specific suggestions for future research that regulators may wish to explore to fill gaps in current knowledge of the use of behavioural insights to improve safety are found at the end of this chapter.

Box 1.3. The BASIC approach to behavioural insights

In 2019, the OECD released the BASIC framework, which is an acronym for the 5-step process of applying BI throughout the policy cycle. The steps are:

1. **Behaviour**: Identify and better understand the policy problem, including its structural and behavioural drivers.
2. **Analysis**: Review the available evidence to identify the behavioural drivers of the problem.
3. **Strategies**: Translate the analysis into strategies to address the behavioural problem.
4. **Intervention**: Design and implement an intervention to test which strategy best addresses the problem.
5. **Change**: Develop plans to scale what works into full policy solutions, sustain behaviour and communicate results.

OECD (2019[1]) contains a detailed description of the framework in a toolkit that provides the policy makers with best practice tools, methods and ethical guidelines for conducting BI projects from beginning to end.

Source: OECD (2019[1]), *Tools and Ethics for Applied Behavioural Insights: The BASIC Toolkit*, Paris, https://doi.org/10.1787/9ea76a8f-en.

Understand the group you are trying to influence

Different groups experience different barriers to action. As such, different behavioural insights should be tested with different subgroups. This study has identified specific dimensions of difference that should be considered to inform the targeting of behavioural insights and contribute to elements of safety culture—especially its behavioural elements. Key dimensions to consider are: 1) the perceived safety culture of the organisation and sector; 2) the role and status of individuals within organisations; and 3) the type and size of the organisation.

1. Perceived level of safety culture of organisations and sector

The perceived level of safety culture of respondents influenced their responses to the tested behavioural insights. Overall, respondents who perceived a higher safety culture were more responsive to the behavioural insights as indicated by a more optimistic perception of the effect that the behavioural insights would have on safety-culture related behaviours. More importantly, the types of behavioural insights that were most effective differed between those who perceived a low safety culture compared to those who perceived an average or high safety culture. On the low end, the use of norms was more effective. On the higher end, messengers and feedback were more effective (see Table 1.3).

This suggests the importance of the relative position of the respondent in terms of their perception of safety culture and safety behaviour. If they perceive safety culture as low, then they may be influenced to improve when they are shown a descriptive norm that is superior to their perceived position. Meanwhile, among those who already have a positive perception of safety culture, it can be more effective to provide feedback from a person or organisation with higher perceived status and expertise regarding safety.

Implications for policy makers:

1. Measure a proxy for safety culture and then investigate ways to use this to differently target regulated entities with low and high safety culture.
2. Test the use of behaviourally informed feedback for organisations with high safety culture.
3. Test the use of descriptive norms among organisations with low safety culture.

Table 1.3. Target BI based on perceived safety culture

Perceptions of Safety Culture	Promising Behavioural Insight	Data Source
Low	Norms (Descriptive)	Ireland (P1), Mexico*
Average / High	Feedback, Messenger	Ireland (P1), Oman

Note: P1 = Phase 1. All groups in Mexico reacted more strongly to the norm vignettes; however, as a country and sector, Mexico had a low safety culture overall (5.10) and therefore the use of positive descriptive norms may be effective country-wide in a low perceived safety culture context.

2. Role and status of individuals within organisations

The status of individuals within an organisation made a difference for targeting behavioural insights. Specifically, the most effective messenger differed by the relative status of the targeted regulated entity (see Table 1.4).

Taken together, the evidence from Phase 1 and Phase 2 suggest that the messenger should be of higher status while being as socially close as possible – essentially the ideal messenger is one step 'above' but not far removed. As such, small-scale entities were more responsive to messages from their trainers, front-line staff of large-scale entities more responsive to messages from their managers, and managers were more responsive to messages from the regulator.

Implications for policy makers:

1. Map the different levels of social status among regulated entities and regulatory bodies, ideally keeping this to a small number such as three or four tiers of social groups with varying status levels.
2. Test the matching of message recipients with messengers who are from the closest social subgroup with higher social status.
3. Highlight what the messenger holds in common with the recipient and why they are an expert related to safety.

Table 1.4. Target BI based on status of recipient

Status of Recipient	Promising Behavioural Insight	Data Source
Small-scale entity	Trainers as the messenger	Ireland (P2)*
Frontline at large-scale entity	Managers as the messenger	Canada, Ireland (P1), Mexico, Oman
Manager at large-scale entity	Regulator as the messenger	Canada, Ireland (P1), Mexico, Oman

Note: P1 = Phase 1, P2 = Phase 2. The most robust finding was that Registered Gas Installers (RGIs) in firms were more responsive to trainers as messengers. However, the Registered Electrical Installers (RECs) in firms were more responsive to messages from the CRU.

3. Type and size of the organisation

Results suggest that the type and size of organisation should also inform how to target behavioural insights (see Table 1.5). Differences in entities responsiveness to behavioural insights include differences between regulators and regulated entities in both phases, differences between sectors in Phase 2 (gas and electric), and differences between the size of the regulated entities (comparing Phase 1 and Phase 2 results).

Encouragingly, regulated entities were more responsive to behavioural insights than regulators. This suggests that although the staff of a regulator may be sceptical about the added utility of behavioural insights, the regulated entities are likely to be more responsive, and therefore regulators should avoid premature scepticism. The smaller regulated entities in Phase 2 were more responsive to messenger effects and this was also mentioned in the qualitative responses in Phase 1. Meanwhile, the provision of feedback and the use of managers and regulators as messengers were more effective for larger regulated entities.

Implications for policy makers:

1. Test different behavioural insights with regulated entities of different sizes.
2. Changing the messenger may be particularly effective for smaller regulated entities.
3. Providing feedback from managers and regulators to larger regulated entities can be effective.

Table 1.5. Target BI based on organisation size and type

Type of organisation	Promising behavioural insight	Data source
Individual-based small-scale entity	Not responsive to primacy, implementation intentions, or messenger effects. Disliked personalisation.	Ireland (P2)
Firm-based small-scale entity	Responsive to primacy, implementation intentions, personalisation, and trainers as messengers.	Ireland (P2)*
Firm-based large-scale entity	Responsive to managers and regulators as messengers. Feedback is most promising, but how to most effectively provide feedback is not clear.	Canada, Ireland (P1), Mexico, Oman
Regulators	Least responsive to behavioural insights.	Canada, Ireland (P1), Mexico, Oman

Note: P1 = Phase 1, P2 = Phase 2. These findings only held for the gas installers not electricity installers.

Targeting specific subgroups will increase the effectiveness of the application of behavioural insights to change factors related to safety culture. Not only does such targeting influence the choice of which behavioural insights to apply (see the three tables above), it also changes how those behavioural insights

should be constructed. For example, each group would have a different high-status messenger that is socially proximate, feedback would be benchmarked to the relevant subgroups were possible, norms would be associated with that subgroup (or a higher performing, socially similar subgroup), the behaviour to list first (primacy) and how to leverage implementation intentions needs to align with the most important actions (and gaps) for that subgroup, and personalisation should be tailored accordingly. Therefore, these findings suggest the importance of using targeted behavioural insights – with targeting based on baseline safety culture, status, and organisation.

Finally, the apparent discrepancies in findings across this research can be resolved by considering the above target groups and the importance of the relative position of respondents and entities. Most notably, for messenger effects, peers were the least effective in Phase 1, but peer-trainers were the most effective in Phase 2. However, in Phase 1, the "peer" messenger had no heightened status and the message was "by word of mouth". Meanwhile, in Phase 2, the size of the entities were smaller, the "peer-trainers" were higher status (not direct peers), and the hypothetical message was delivered in writing. So a peer with higher status seems effective. This is also supported by the fact that the regulator was not the most effective messenger for frontline staff in Phase 1, but rather managers who were socially closer but still of higher status.

Apply the behavioural insights principles most effectively

This study (Phases 1 and 2) explored the effects of six different behavioural insights principles on hypothetical behaviours related to safety culture of regulated organisations within the energy sector. The following provides the findings with regards to each of the six and how they might be productively applied by regulators to improve safety culture.

1. Norms

Norms are a central part of any conceptualisation of safety culture. Where there is data on a desirable safety behaviour across an energy sector with multiple regulated entities, descriptive statistics about people's actions can be generated to provide evidence-based descriptive norms of what entities are doing. These descriptive norms can then be sent to regulated entities who are performing below the norm to encourage them to improve and therefore move closer to the norm.

Where data do not exist or where there are few entities, the use of descriptive norms is not possible. However, where the data exist, they can be an effective means to improve the safety behaviour of underperforming entities. The results do not support sending descriptive norms to entities who are performing better than the norm. The study also did not find evidence to support the use of injunctive norms that simply state what the behaviour *should* be.

2. Messengers

Regulators choose who communicates regulations and recommendations to regulated entities. Those entities must choose who to communicate those messages to their management and staff. Each of these messages has a messenger, and the social proximity and social status of that messenger vis-à-vis the recipient matters. Who the messenger is can increase or decrease the likelihood that a safety related directive or recommendation is noticed or enacted.

This study recommends segmenting potential message recipients by social group and status and then assigning messengers who are as socially close to the recipient subgroup as possible while having higher status. The use of different messengers can and should be combined with a consistent underlying message – even if the framing differs, the content should be consistent. The results suggest avoiding informal communication methods and the use of direct peers as messengers unless they have a higher status (for example, due to being trainers).

3. Feedback

Feedback is key part of any learning and continuous improvement process, including safety. Where there is no feedback given to regulated entities on safety, such a practice could be institutionalised within the regulatory framework. In addition to creating new opportunities for feedback, regulators can productively make use of existing interactions and communications to provide feedback. One example, is providing behaviourally informed feedback during and after inspections.

Because this study does not find direct evidence that a particular mode of feedback is more effective, it is recommended to combine feedback with one of the other behavioural insights such implementation intentions. Providing feedback is particularly significant for regulated entities who are performing above the norm across desired safety behaviours, but in those cases it should not be paired with descriptive norms due to the risk that they will decrease their exceptional efforts when they see that they are exceeding the norm.

4. Primacy

The first item in a list, or the first activity in a plan, often gets more attention than latter items. This insight can productively be applied to the design of safety inspections and the ordering of content in safety-related communications from regulators. This insight can help ensure that sufficient attention is paid to address weak safety areas by placing them first in inspections and communications.

Periodically the ordering of such actions and communications could be adjusted based on shifting priorities – as the needs change, the order may need to change. However, such dynamic changes should be done carefully, should be tested, and should not be done too frequently. Frequent changes to the order of procedures and communications may confuse those it is meant to help.

5. Implementation intention

Making a concrete, time-bound plan to take an action to improve safety can increase the likelihood of that safety behaviour being implemented. This is the power of implementation intentions, and it can be productively linked to multiple behaviours. This insight can be particularly useful in supporting the initial choice to act and the continued determination to do so (the CD of the ABCD framework, presented in OECD (2019[1]). As a result of this, implementation intentions can be productively combined with behavioural insights that focus more on the attention (A) and belief (B) of regulated organisations and their constituent staff members.

As far as possible, implementation intentions should be as specific as possible and should be linked to times, places, and routines of existing importance for the entities in order to be most effective. Due to the effectiveness of implementation intentions, it is particularly important that the prompted safety action be informed by evidence.

6. Personalisation

The personalisation of safety directives or recommendations can be an effective way to increase the likelihood that organisations pay attention to the message. Personalisation can range from ensuring that a message uses the name of each recipient organisation, to messages embedded with specific safety-related data, requirements, and recommendations that are unique to the organisation receiving the message.

This study finds that such personalisation can be productively deployed for small-scale regulated firms and previous research has found personalisation to be effective among individuals with regard to different contexts and topics. However, the results do not support personalisation being used for self-employed individuals who are classified as regulated entities due to the negative effects found during our Phase 2

study. More generally, the potential negative reaction of recipients who have privacy concerns should be weighed against personalisation.

Table 1.6. Six behavioural insights and implications for policy and practice

Behavioural insight	Implication for policy & practice	Data sources
Norms	Descriptive norms may work best among those with a low perceived safety culture in their organisation who are in a country with a high safety culture. Injunctive norms are not recommended based on these results.	Ireland, Mexico, Oman
Messenger	Messengers should have a higher status than the recipient, but should share a social milieu: i.e. the nearest higher-status messenger with legitimacy.	Canada, Ireland (P1, P2), Mexico, Oman
Feedback	Feedback resulted in the largest changes in hypothetical safety culture related behaviour. The effectiveness of existing feedback mechanisms, such as inspections and reports, can be strengthened through adding behavioural insights (especially implementation intentions).	Canada, Ireland (P1, P2), Mexico, Oman
Primacy	Changing the sequencing of inspections to prioritize areas with high safety concerns does not have a clear effect in isolation, but it is effective when combined with an implementation intention committing to take action. This suggests that primacy might direct attention but is insufficient to translate into action and thus needs to be combined with an 'action-focused' behavioural insight such as an implementation intention. Such combinations should be further tested.	Ireland (P2)
Implementation Intention	Implementation intentions are a powerful behavioural insight that have been effective in other contexts and were also effective in increasing follow-through actions related to safety culture among gas installers. This 'action-focused' behavioural insight should be tested in combination with 'attention-focused' behavioural insights (such as primacy, personalisation, and others). Such combinations should be further tested.	Ireland (P2)
Personalisation	Personalisation does not function in a predictable manner in these contexts. Given the recent rise in privacy concerns, it may be more productive to add personalised information about the organisation but not the individual.	Ireland (P2)

Note: P1 = Phase 1, P2 = Phase 2.

Acknowledge the limitations

These findings and implications should be tempered by the limitations of our studies. On the one hand, this work was frontier research into an area of regulatory policy that is relatively understudied. On the other hand, due to the nature of the experimentation, the sample sizes and results varied significantly. Taken together, additional research would be needed to research further how many of the behavioural insights function in relation to safety and confirm details of the findings presented above.

Concretely, some limitations of this study include:

- The complexity of the concepts, contributing factors, and effects of safety culture and safety behaviours.
- Behavioural insights do not constitute a "silver bullet" – or cure-all – and need to be used as part of a holistic approach to enhancing safety culture and improving safety. Regulators should consider the relative role of behavioural insights vis-à-vis traditional regulatory tools and structural changes to sectors and organisations to improve safety.

- Further research is needed into actual behaviours, as opposed to the hypothetical behaviours captured as part of the survey experiments conducted in both phases of this study. In fact, this study has yet to move to the final stage of testing observed behaviour through focus groups (which are commonly used in the study of safety culture) or field experiments, as recommended above as part of a multi-staged process for applying BI. As such, these studies should be followed by field experiments.
- Feedback, norms, and personalisation used within the studies were all fabricated to ensure consistency, and future research should also try to develop such behavioural insights using real data from the relevant organisations and sectors.
- Small sample sizes in some countries limited the ability to generate findings for specific subgroups of respondents. This particularly limited our ability to draw out inferences for Canada in Phase 1 and from analysing differences for newly registered entities (less than one year since registration) in Phase 2.
- Findings from Phase 2 are specific to the context of Ireland and therefore should be treated with caution when extrapolating from the findings to other contexts and cultures.
- While direct causal inferences can be generated due to the randomised controlled trial design, overall implications drawn from across the studies and subgroups are more speculative. This is inevitably the case when trying to draw out policy and practice implications from a controlled study.

Build on the results with future research

We suggest the following avenues for future research to be explored jointly by regulators and researchers. Such research will help advance our understanding of this new and important tool for advancing safety among regulated entities. The areas for future research are divided into research on the direct effects of behavioural insights and research into the mechanisms of those effects.

1. Improving our understanding of direct effects

- Conducting survey experiments in new country-contexts that attempt to replicate and extend the findings presented here.
- Conducting survey experiments on the effects of using norms, feedback, and personalisation that is linked to actual safety data across the sector and within each targeted regulated entity.
- Conducting survey experiments that combine the most effective behavioural insights identified in this work into new combinations, for example combining feedback and implementation intentions.
- Conducting field experiments to test if the impacts identified in our survey experiments translate to observed safety-related behaviours in the real world.

2. Improving our understanding of the mechanism behind effects

- To better understand how relative status and social group changes the effectiveness of messenger effects, various combinations of these relative positions should be tested to determine the best safety messengers. This could be done through a survey experiment.
- To better understand how perceptions of safety culture interact with behavioural insights, a survey experiment should be designed in which perceptions of safety culture are first measured, and then those with high, average, and low safety culture should be stratified before randomising each strata into subgroups for testing the effectives of different behavioural insights among groups with different perceptions of safety culture.

Notes

[1] OECD (2014[36]) defines a regulator as an entity authorised by statute to use legal tools to achieve policy objectives, imposing obligations or burdens through functions such as licensing, permitting, accrediting, approvals, inspections and enforcement, as well as complementary tools such as information campaigns. There are many types of regulators, including economic, financial, competition, consumer protection, technical and/or some that mix these roles. Economic regulators often focus on economic and competition/consumer protection functions in key economic sectors – such as energy, transport, telecommunications, and water – where the market is usually dominated by natural monopolies often under the responsibility of large state-owned or private corporations.

[2] Formerly the National Energy Board of Canada (NEB), which was renamed to CER in August 2019.

[3] Vignettes are often used in psychology experiments to describe a certain situation/context, ensuring control across study participants.

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2 Beyond the individual: why and how behavioural insights can be applied to organisational behaviour

This chapter seeks to elaborate a theoretical model for applying behavioural insights to changing organisational behaviour, based on lessons from Industrial-Organisational Psychology.

The basis for examining the theoretical foundations for the application of BI to organisations for policy makers is two-fold. First, OECD (2017[1]) provides the first ever global collection of case studies on the application of BI to public policy, with over 110 cases across 11 policy domains. The majority of these cases are BI applied to individual behaviour, such as consumer protection/choice, tax compliance, sustainability, and retirement saving. This is perhaps unsurprising, as BI began as a discipline needing to prove its ability to provide a positive return on investment (Halpern, 2015[2]). However, regulatory policy includes policy problems that are often more complex than changing biases that drive errors in individual decision making; rather, they involve interactions between consumers, firms, government and the legal structures that govern the entire relationship. This is especially true for fields such as regulatory policy, where changing firm behaviour is often the primary goal of regulation.

Second, the natural follow up then is to examine how lessons learnt from influencing individual behaviour can be translated to influencing organisational behaviour, or if we need new lessons altogether. Fundamentally, when it comes to influencing behaviour, it is arguably less a matter of influencing whole organisations *versus* the people inside of them, and more a matter of influencing whole organisations via the people inside of them – and via the organisational policies and procedures set in place by decision makers. In the development of the Attraction-Selection-Attrition framework explaining how organisations evolve toward psychological homogeneity, organisational scholar Benjamin Schneider stated, “The people make the place” (De Cooman et al., 2009[3]); (Schneider, Goldstein and Smith, 1995[4]). Organisations are made up of people. By influencing the right number or types of people and/or by tweaking the right policy levers in organisations, whole organisations can change.

This logic is normal when viewed through the prism of organisational reform. Reviewing, analysing and providing recommendations for organisational reform is the “bread and butter” of the OECD, who engages in reviews of member and non-member countries across all policy areas and often with regards to one government entity, such as regulatory authorities. While not expressly behavioural, a natural component to any review methodology is an analysis of the routines, policies and procedures of the organisation in an attempt to discover possible misaligned incentives or missing policies that are affecting the good governance and performance of the organisation. Inherently, this is partly behavioural. For example, the Performance Assessment Framework for Economic Regulators (PAFER) looks at four dimensions of governance and performance: roles and objectives; inputs; processes; and outputs and outcomes (see (OECD, n.d.[5]). Each dimension looks at both structural barriers and behavioural barriers, such as the need for high quality strategic objectives. This is a necessary structural requirement for any organisation, while the process of developing strategic objectives involves engaging all levels of staff and external stakeholders. The manner and perception of this process inherently creates behavioural effects that may need to be managed and addressed.

For government then, the application of behavioural insights to organisations is often done by influencing specific individuals in those organisations to affect organisation-wide changes or by more directly intervening on organisational routines, policies, and procedures of the organisation. This chapter will provide the theory of how organisational behavioural can be influenced, and what lessons do policymakers need to learn in order to adapt BI to organisational behaviour. It was originally created as a background paper for the OECD-European Commission Seminar on “Behavioural insights and organisational behaviour” held on 10 May 2017 at the OECD Headquarters in Paris, France, financed by the European Commission Directorate-General for Regional and Urban Policy, and summarised in OECD (2018[6]).[1]

Applying Behavioural Insights to Organisations: Theoretical Foundations

When enough people are nudged toward behavioural change, those new behaviours have the potential to become habit, switching from deliberate choices and actions otherwise known as controlled processing, to less deliberate, less effortful, more habitual actions known as automatic processing. Whether deliberate or

effortful, choice or habit, when enough people in a work group or entire organisation behave in a certain way, that behaviour has the potential to become a norm. Norms are rules for expected and accepted behaviour. As humans, violating norms tends to make us uncomfortable. We are likely to conform to the norms of our work group and organisation.

This is especially true of cohesive groups who feel a degree of attraction to their work group. Years of research in psychology support this assertion, which is also likely supported by the reader's own work experiences. Within an organisation, people conform to norms as seemingly trivial as dress code and where to sit during lunch breaks to those more important such as communication styles and production rates. Thus, nudging a critical mass of people such that the "new" behaviour becomes a norm is a mechanism by which to nudge an entire organisation.

Nudging leaders is another way to nudge entire organisations. Leaders are those with influence. This includes those officially designated as leaders, as well as those with power and influence for other reasons. There are purported to be five bases of power in organisations: expert, referent, reward, coercive, and legitimate (French and Raven, 1959[7]); (Hinkin and Schriesheim, 1989[8]). Expert power arises from relevant knowledge of a subject matter: Someone with a unique and important knowledge base in an organisation possesses a particular type of power that can be influential. Referent power arises from being liked and admired by others. Reward and coercive power are often possessed by people in supervisory positions. These refer to the ability to reward others with bonuses, promotions, etc. and the ability to punish others with disciplinary actions, fines, firing, and the like. Finally, legitimate power is the power inherent in a boss or leader's job title. People in organisations may possess one, some, many, all, or none of these bases of power and influence.

Nudging supervisors or other powerful or influential people within an organisation can have a multiplying effect such that the behaviours exhibited and endorsed by influential individuals have a better chance of being adopted *en masse*, nudging a whole organisation in the process. Indeed, charismatic and transformational leaders are believed to possess qualities that inspire followers to behave in desired ways in service of a larger goal. Nudging such leaders can effect largescale behavioural change.

Of course, those in formal leadership roles toward the top of the organisational hierarchy are also in a good position to effect widespread behavioural change by altering organisational policies and procedures. Nudges that help high-level decision makers (leaders, boards, etc.) optimize organisational policy decisions in the face of their own biases and irrationalities can have an effect. Thus, helping decision makers see the connection between policies, procedures, and behaviour on the ground is another way to nudge whole organisations. It has been argued that behavioural nudges should be part of policymakers' toolkits (Guszcza, 2015[9]). This is just as true for those setting organisational policy as it is for those setting policy in other contexts such as government.

This last point warrants special emphasis. Organisational policies and procedures affect behaviour at work by shaping who is doing the work and how they are doing it. Organisations can be strategically and intentionally nudged by using behavioural science (theories, methods) to inform those policies and procedures. Said another way, behavioural insights can help organisations develop behaviourally informed policies and procedures. Rather than hoping for human behaviour that supports the policies and procedures in place, it is a matter of creating policies and procedures that will encourage the work behaviours that support the broader mission and vision of the organisation at hand.

So, can whole organisations be nudged? The short answer is "yes." The longer answer is "Yes, but …" The caveat is this: In order to effect widespread organisational change, we need to incorporate and go beyond traditional nudge techniques used in behavioural economics.

In a sense, nudging entire organisations requires both a narrower and broader focus than we typically see in behavioural economics. The focus can be narrower in that it is constrained to work and organisational behaviour in particular, addressing the phenomena of greatest relevance and concern within the working

context – worker and organisational wellbeing, work motivation, efficiency, effectiveness, productivity, and so forth. At the same time, the pursuit of organisational nudges requires a widening of the metaphorical aperture. The theoretical and methodological focus needs to encompass, incorporate, and integrate traditional behavioural economics approaches with years of science that has accumulated in other relevant fields, most notably industrial and organisational psychology, discussed next.

Industrial-organisational psychology

Traditionally, there has been a strong reliance on psychology in behavioural insights (BI) interventions and teams. Indeed, psychologist Daniel Kahneman, who won the 2002 Nobel Prize in Economics, is often considered the father of behavioural economics. Historically, insights from social psychology and cognitive neuroscience have been especially prominent in shaping BI theory and applications.

The neighbouring sub-discipline of Industrial-organisational (I-O) psychology becomes especially relevant as we more carefully consider how to use BI to enhance organisational behaviour. I-O psychology is "the scientific study of working and the application of that science to workplace issues facing individuals, teams, and organisations. The scientific method is applied to investigate issues of critical relevance to individuals, businesses, and society" (SIOP, n.d.[10]).

As this definition shows, I-O psychology is clearly at the intersection of BI and organisational behaviour. Accordingly, I-O psychology has a notable influence in this paper. As an applied discipline that closely adheres to a scientist-practitioner model, I-O psychology draws from and contributes to a range of neighbouring sub-disciplines in psychology and business. Academics in this field are commonly housed in business schools if not psychology departments and publish in business, management, psychology, and trade journals. Practitioners play a prominent role in government, military, non-profit, and for-profit entities. Increasingly I-O psychology is being applied directly to development goals and organisations, such as the United Nations.

In light of its increasingly prominent role in the public and private sectors, I-O psychology has recently been ranked among the fastest growing jobs in the U.S. economy by the Bureau of Labor Statistics (2014). All signs suggest that it is growing in other parts of the world as well, with recent years witnessing, for example, the first Ph.D. in I-O psychology awarded within the country of Ghana (Oppong, 2013[11]). Alternate names for I-O psychology in various parts of the world include Work Psychology, Organisational Psychology, Work and Organisational Psychology (WOP), and Business Psychology. In Europe, there is an Erasmus Mundus postgraduate program in Work, Organisational, and Personnel Psychology (WOP-P) devoted to building expertise in WOP-P for an increasingly globalised socio-economic world of work.

Industrial-organisational psychologists' methodological toolbox is vast, including a mixture of methods to answer questions about work behaviour: lab studies, field research, Randomized Controlled Trials, quasi-experimental designs, correlational designs, validation studies, and so forth. In addition, a mixture of analytics is also used: ANOVA, regression, multilevel modelling, factor analysis, cluster analysis, and a variety of other techniques. Because of the focus on applying psychological methods and theories to real-world problems, I-O psychology expertise has been included in behavioural insights groups, including on the White House Social and Behavioural Science Team (SBST; (Stillman, 2017[12]).

Methods for applying behavioural insights to organisational behaviour

Define, Diagnose, Design, Test

One important commonality between I-O psychology and behavioural economics is the define-diagnose-design-evaluate approach to implementing and testing behavioural nudges (see Figure 2.1). This entails, first and foremost, carefully defining and agreeing upon the institutional problem or challenge that needs

to be addressed. Defining the problem in precise, concrete, behavioural terms can be difficult. It takes time, investigation beneath the surface, an objective consideration of a variety of alternatives.

Figure 2.1. Define, Diagnose, Design, Test Model

Source: Adapted from UNDP (2016[13]).

At times, behavioural scientists solicit subject matter expertise via informational interviews and observations during the problem definition phase of the process. Silva (2017[14]) summarises this process from experts and stakeholders working within and alongside the United Nations. In this example, participants with different perspectives (country offices, agencies, etc.) helped identify “pain points” and opportunities to strengthen innovation at the United Nations.

The second step is to diagnose: What are the barriers or bottlenecks discouraging the desired behaviours? What aspects of the environment might be reinforcing the less desired behaviours? Each stage of the relevant actors’ decision making process is examined here to determine what cognitive biases or other factors might thwart efficiency or effectiveness. In an organisational context, additional questions asked at this stage may entail whether there is a skill deficit, a barrier preventing skills from being utilised on the job, role ambiguity, a communication issue, a motivational problem, or a formal or informal reward structure inadvertently reinforcing less desired behaviours. This paper elaborates on some of the factors that should be considered when diagnosing effectiveness and efficiency problems at work.

The Critical Incidents Technique is a job analysis tool often used by industrial-organisational psychologists, which can be informative during the diagnostic phase of a change initiative. Developed in the 1950’s by John C. Flanagan, this well-established technique entails using a specific interview protocol to collect and document stories of effective and ineffective behaviours at work, related to superior or inferior performance (Flanagan, 1954[15]). This technique can be applied to individual or group behaviour. Through the collection and content analysis of hundreds of “critical incidents,” the organisation can get a good picture of behavioural bottlenecks ripe for intervention. The critical incidents technique has been used to teach best practices in a variety of industries including healthcare, counselling, and customer service (Rademacher, Simpson and Marcdante, 2010[16]).

The third step is to design an intervention to address the challenge at hand using what we know about human behaviour in a work context. There are a variety of nudge-style tools that may inspire relevant interventions at this stage, including simplification, active choice, the use of social norms, and implementation intentions. In addition to nudge-style tools, there are other distinct as well as some overlapping techniques commonly employed by industrial-organisational psychologists during the intervention phase of the process – including goal setting, redesigning work, and tweaking staffing, training, performance management, and reward systems.

The fourth and final step in the process is evaluation. To date, behavioural economists have relied heavily on Randomized Controlled Trials (RCTs) to test interventions. This entails exposing a random subset of the workforce to the intervention in question and comparing their behaviour to that exhibited by their counterparts in a control group that was not exposed to the intervention. There are clear benefits to using an RCT methodology to test an intervention. Internal validity is high. Causal relationships can be conclusively determined.

It should be noted, however, that organisational phenomena do not always lend themselves to the RCT methodology. Institutions interested in using behavioural insights to effect change will restrict what they can learn and change by limiting their interventions to those that can be tested via an RCT. A bigger methodological toolbox – one that includes but is not limited to RCTs – is arguably needed when applying behavioural insights to institutions and organisations. Indeed, Kanfer and Chen (2016[17]) conclude their review of work motivation with a discussion of the need to integrate emerging insights from various sub-disciplines, emphasising the need for researchers to expand beyond the standard, time-limited, experimental paradigm. They "strongly encourage the use of multi-level, longitudinal field experiments, experience-sampling studies, and intervention studies to allow for the evaluation of motivational and behavioural variability as a function of time, work events, the individual's history, and the social context of action – determinants of motivation particularly important for managing many modern organisational behaviour problem spaces, such as expatriation, work transitions, employee diversity, multi-team systems, and high-stakes work" (p. 15).

Behavioural design thinking

When crafting behavioural interventions, it is helpful to make use of several frameworks that have been used previously. The following is a sketch of the steps of thinking through how to apply behavioural insights in your work:

- **Define the Problem**: Develop a clear understanding of a particular behaviour that should be increased or decreased. Frame the behaviour as much as possible by specifying who it is done by, where it occurs, and when it is usually done.
- **Diagnose the Barriers**: Look for the barriers that are preventing the desired action or that are preventing a negative action from ceasing. It is often more productive to start by identifying existing barriers before moving to solutions. Types of barriers worth considering are:
    1. **Awareness**: does the person or organisation know about the behaviour? Do they know that it is (un)desirable? Do they know the ramifications?
    2. **Motivation:** what are the things that are making them unmotivated to act?
    3. **Behaviour:** are there issues with the ease or complexity of the action itself that are preventing action even among those who are aware and motivated?
    4. **Continuation:** does the action require continuous follow-up? Is it likely that the follow-up actions are forgotten due to long time lags? Are there motivational hurdles to sustained action?
    5. **Feedback:** is there a lack of feedback such that individuals are not even aware that they completed the action? Is there feedback that might incentivize them to avoid future action or dissuade others from acting?
- **Design the Intervention:** Look for behavioural insights that have been successful in previous cases that can help with addressing the identified barriers. When designing the intervention, it is useful to look for existing systems that can be adapted. In particular, look for existing points of contact with the audience, partners that can implement the desired change, and any data that can help target the intervention in a precise and personalised manner.
- **Evaluate**: Test the effectiveness of the change to add to the knowledge of your organisation and the broader community about what works, when, where, and for whom. The use of behavioural insights is still in its early states and applications that have worked in different contexts with different populations might not work new contexts. Quick, low-cost, and rigorous evaluations can often be done by using existing sources of administrative data and will inform future policy-makers and practitioners.

Organisational behaviour through individuals: 8 things psychology tells us about work and organisational behaviour

Given the relevance of psychology to the world of work, there is value in highlighting key psychological insights that can be applied to those interested in nudging organisational behaviour. While an exhaustive list of relevant psychological theories is beyond the scope of this chapter, the following pages describe some of the more pertinent insights, which may directly or indirectly stimulate solutions to a variety of organisational challenges.

1. Rewards can motivate and backfire

Official and unofficial reward structures are important levers to examine when considering organisational nudges. Years ago, former president of the Academy of Management, Steven Kerr, wrote one of the most widely cited articles in the management sciences, which continues to be discussed and reprinted today given its relevance to modern organisational challenges. It is titled, "On the folly of rewarding A, while hoping for B" (Kerr, 1995[18]).

To motivate behaviour in the desired direction, reward structures need to be aligned with organisational objectives. Kerr provides examples from politics, medicine, the military, universities, sports, government, and business in which the types of behaviour rewarded are those we wish to discourage, while the desired behaviour is not being rewarded at all. For instance, he comments on governments' distribution of funding, where the allocation of next year's budget is often a direct function of this year's expenditures. While the government likely hopes for economy and prudence in spending, it is rewarding just the opposite.

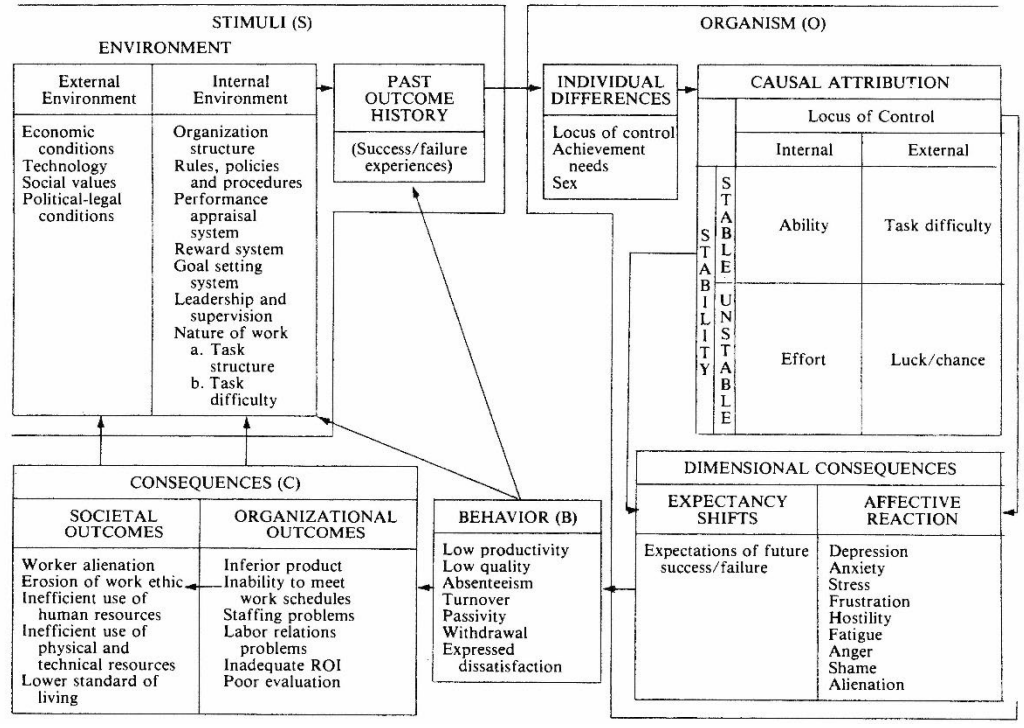
Kerr describes additional examples as well. He comments on the folly of rewarding individual effort when we hope for teamwork. This likely applies across institutions as well as it does within institutions. If success hinges on effective communication and collaboration across institutions but the workers in the institutions in question are responding to their own individual reward structures, effective collaboration is relatively unlikely. Another example from management relates to the leader who wishes to encourage employees to set challenging "stretch" objectives yet evaluates and promotes people on the basis of whether they have "made the numbers" and achieved goals. Such a reward structure encourages people to aim low.

It is not difficult to conceive of examples outside of government as well. For instance, imagine a university or scientific "think tank" hoping scientists will produce innovative research and development. Typically, researchers' protocols need to be submitted and approved by an institutional review board (IRB) before the research can begin. IRBs that are overly concerned with staying out of legal trouble or avoiding "attacks" from external stakeholders concerned with unprecedented research protocols will tend to be risk averse, rejecting innovative protocols in favour of the status quo, or requiring modifications that not only create administrative roadblocks but would also render the research far less innovative than it could have been. Legal concerns and fear of external stakeholders may also lead to multiple audits or reporting requirements throughout the research process, which can slow down progress and distract the researchers from innovation. Thus, while the institution is hoping for innovation, it is rewarding safe, status-quo projects and time spent fulfilling reporting requirements.

Kerr (1995[18]) points out several causes of the inconsistency between what is hoped for and rewarded, including a fascination with "objective" criteria and an overemphasis on highly visible behaviours. Organisations need criteria by which to judge success, measure and reward performance. Often, this leads to countable metrics (money spent, time spent, forms completed, etc.) that are contaminated by factors outside of worker or project manager's control and/or deficient in that they are not tapping into important components of effectiveness and work quality. This is often coupled with an undue emphasis on highly visible behaviours. Team building and creativity are examples of behaviours which may not be rewarded because they are difficult to observe and measure, even though they are important.

At a more micro (psychological, behavioural) level of analysis, we can consider how people will respond when organisational reward structures punish hoped-for behaviours. Learnt helplessness is a behavioural insight that likely plays a role. Years of research in psychology demonstrate that people are susceptible to learnt helplessness: We become passive or stop trying after repeated punishments or failed attempts at a task. Unfortunately, this passivity persists even after the environment changes in a way that would make success possible with further attempts. Organisational scholars have long recognised that this phenomenon occurs in our work lives just as it does in our personal lives. Figure 2.2, for example, shows Martinko and Garnder's (1982[19]) conceptualisation of Organisationally Induced Helplessness – demonstrating how rigid organisational policies and structures, coupled with a perceived lack of control, results in passive, maladaptive behaviour in organisations. A study published in the *Journal of Organisational Behaviour* demonstrates that this is neither an exclusively Western phenomenon, nor a phenomenon of days gone by. The article, titled "Tired of Innovations? Learned Helplessness and Fatigue in the Context of Continuous Streams of Innovation Implementation" is based on data from 84 managers and 397 employees of Chinese and Korean organisations. Results demonstrate how employee behaviour toward future innovation is shaped by perceptions of helplessness and fatigue resulting from previous unsuccessful innovation attempts (Chung, Choi and Du, 2017[20]).

Figure 2.2. A model of organisationally-induced helplessness



Source: Reprinted from Martinko and Gardner (1982[19]).

In the context of the preceding IRB example, learnt helplessness can set in at several levels. First, it may affect the researcher whose innovative ideas are repeatedly denied or punished through additional paperwork requirements, revisions, justifications, or reporting requirements. Second, it may affect IRB decision makers who themselves have been punished for supporting innovative ideas, either through legal action, threats thereof, unwanted attention from external stakeholders, or heightened workload (justifications, reporting requirements). As new employees come on board, this "It can't be done" mindset is likely to be transmitted via the organisational socialisation process. Denying innovative proposals is thus likely to become part of the norm to which workers conform.

There is no single, simple solution to this problem. As Figure 3 suggests, work behaviour does not "exist in a vacuum," so to speak, but is influenced by a variety of factors interacting in concert. Nevertheless, with a diagnosis in place, we can begin to use behavioural insights to address the problem. The first part of the solution is ensuring that organisational policies and procedures allow for, encourage, and reward innovation at varying levels – and revising policies if necessary. In the parlance of Kerr (1995[18]) the organisation(s) hoping for B need to may sure B is being rewarded. This may require helping decision makers balance risk with innovation, and understand the behavioural consequences of going too far in either direction. See Shephard (2017[21]) for a discussion of using behavioural insights to support decision makers in balancing risk and innovation.

Notably, revised policies alone may not be enough. If learnt helplessness has set in, freeing constraints will not change behaviour. Here, it is worth pointing out the motivating influence of self-efficacy and "meaning" in our work. Assuming organisational policies that allow for creativity and innovation are in place, self-efficacy inducing interventions (training, exercises, etc.) may increase confidence in the prospect of carrying out innovation. A transformational leader who helps workers see the meaning in their work can also help. For example, IRB employees may be more receptive to additional workload or reporting requirements triggered by truly innovative ideas if they feel they are contributing to the cause – that is, if they see the connection between these more mundane work-related actions and the more inspirational end goal that the innovation is designed to achieve.

In summary, many times there is an inconsistency between what is hoped for and what is rewarded. Organisations often nudge the workforce in unintended directions via their informal or formal reward structures. Effective solutions to this problem require attention to organisational policies as well as more micro-level psychological consequences of rewards and punishments.

2. There is more to work motivation than monetary rewards and incentives

It is a central theme of economics that incentives promote effort and performance, and there is a lot of evidence that they often do (e.g., (Gibbons, 1997[22]); (Lazear, 2000[23]). In other words, contingent rewards serve as "positive reinforcers" for the desired behaviour. In psychology, their effect is much more controversial" (Benabou and Tirole, 2003[24]) p. 489). Over the last decade or two, economists and psychologists have begun to develop a more common understanding of work motivation. A 2003 article in the *Review of Economics Studies*, for example, asserts that rewards may be only weak reinforcers in the short term and may have hidden costs, becoming negative reinforcers once they are withdrawn (Benabou and Tirole, 2003[24]). A classic explanation has to do with the "overjustification effect" whereby extrinsic incentives and rewards cause workers to conceptualize their motivation to perform a task in external terms (e.g., for a bonus) rather than seeing the task as intrinsically worthwhile. The result is a so-called "crowding out" of intrinsic motivation by external rewards (Gubler, Larkin and Pierce, 2016[25]).

Self-Determination Theory is a macro theory of human motivation that evolved from research on intrinsic and extrinsic motivations and has been expanded to account for work behaviour. In their review of Self-Determination Theory in the *Annual Review of Organisational Psychology and Organisational Behaviour,* Deci, Olafsen, and Ryan (2017[26]) elaborate on the theory, focusing on the distinction between autonomous and controlled motivation, and postulating that all employees have three basic psychological needs – for autonomy, competence, and relatedness (i.e., relationships with other people). Autonomous motivation and high performance result from work environments that satisfy these three needs. Therefore, one component of the diagnostic phase of determining how best to nudge an organisation entails considering the degree to which these needs are being met on the job. Their absence renders an organisation increasingly reliant on external rewards, with motivational effects that are often unsustainable.

Dan Ariely and Adam Grant are two contemporary psychologists whose work has effectively spanned the behavioural economics and organisational psychology domains. As Ariely asserts, "When we think about labour, we usually think about motivation and payment as the same thing, but the reality is that we should

probably add all kinds of things to it: meaning, creation, challenges, ownership, identity, pride, etc." (Gross, 2015[27]). Box 2.1 describes five studies conducted by Ariely and Grant, which support this assertion.

Box 2.1. What Motivates Us at Work? More than Money. Example Research Studies by Dan Ariely and Adam Grant

Seeing the fruits of our labor may make us more productive.

The Study: In Man's search for meaning: The case of Legos, Ariely asked participants to build characters from Lego's Bionicles series. In both conditions, participants were paid decreasing amounts for each subsequent Bionicle: $3 for the first one, $2.70 for the next one, and so on. But while one group's creations were stored under the table, to be disassembled at the end of the experiment, the other group's Bionicles were disassembled as soon as they'd been built. "This was an endless cycle of them building and we destroying in front of their eyes," Ariely says.

The Results: The first group made 11 Bionicles, on average, while the second group made only seven before they quit.

The Upshot: Even though there wasn't huge meaning at stake, and even though the first group knew their work would be destroyed at the end of the experiment, seeing the results of their labor for even a short time was enough to dramatically improve performance.

The less appreciated we feel our work is, the more money we want to do it.

The Study: Ariely gave study participants — students at MIT — a piece of paper filled with random letters, and asked them to find pairs of identical letters. Each round, they were offered less money than the previous round. People in the first group wrote their names on their sheets and handed them to the experimenter, who looked it over and said "Uh huh" before putting it in a pile. People in the second group did not write down their names, and the experimenter put their sheets in a pile without looking at them. People in the third group had their work shredded immediately upon completion.

The Results: People whose work was shredded needed twice as much money as those whose work was acknowledged in order to keep doing the task. People in the second group, whose work was saved but ignored, needed almost as much money as those whose work was shredded.

The Upshot: "Ignoring the performance of people is almost as bad as shredding their effort before their eyes," Ariely says. "The good news is that adding motivation doesn't seem to be so difficult. The bad news is that eliminating motivation seems to be incredibly easy, and if we don't think about it carefully, we might overdo it."

The harder a project is, the prouder we feel of it.

The Study: In another study, Ariely gave origami novices paper and instructions to build a (pretty ugly) form. Those who did the origami project, as well as bystanders, were asked at the end how much they would pay for the product. In a second trial, Ariely hid the instructions from some participants, resulting in a harder process — and an uglier product.

The Results: In the first experiment, the builders paid five times as much as those who just evaluated the product. In the second experiment, the lack of instructions exaggerated this difference: builders valued the ugly-but-difficult products even more highly than the easier, prettier ones, while observers valued them even less.

The Upshot: Our valuation of our own work is directly tied to the effort we have expended. (Plus, we erroneously think that other people will ascribe the same value to our own work as we do.)

Knowing that our work helps others may increase our unconscious motivation.

The Study: As described in a recent New York Times Magazine profile, psychologist Adam Grant led a study at a University of Michigan fundraising call centre in which students who had benefited from the centre's scholarship fundraising efforts spoke to the callers for 10 minutes.

The Results: A month later, the callers were spending 142% more time on the phone than before, and revenues had increased by 171%, according to the Times. But the callers denied the scholarship students' visit had impacted them.

The Upshot: "It was almost as if the good feelings had bypassed the callers' conscious cognitive processes and gone straight to a more subconscious source of motivation," the Times reports. "They were more driven to succeed, even if they could not pinpoint the trigger for that drive."

The promise of helping others makes us more likely to follow rules.

The Study: Grant ran another study (also described in the Times profile) in which he put up signs at a hospital's hand-washing stations, reading either "Hand hygiene prevents you from catching diseases" or "Hand hygiene prevents patients from catching diseases."

The Results: Doctors and nurses used 45% more soap or hand sanitizer in the stations with signs that mentioned patients.

The Upshot: Helping others through what is called "prosocial behaviour" motivates us.

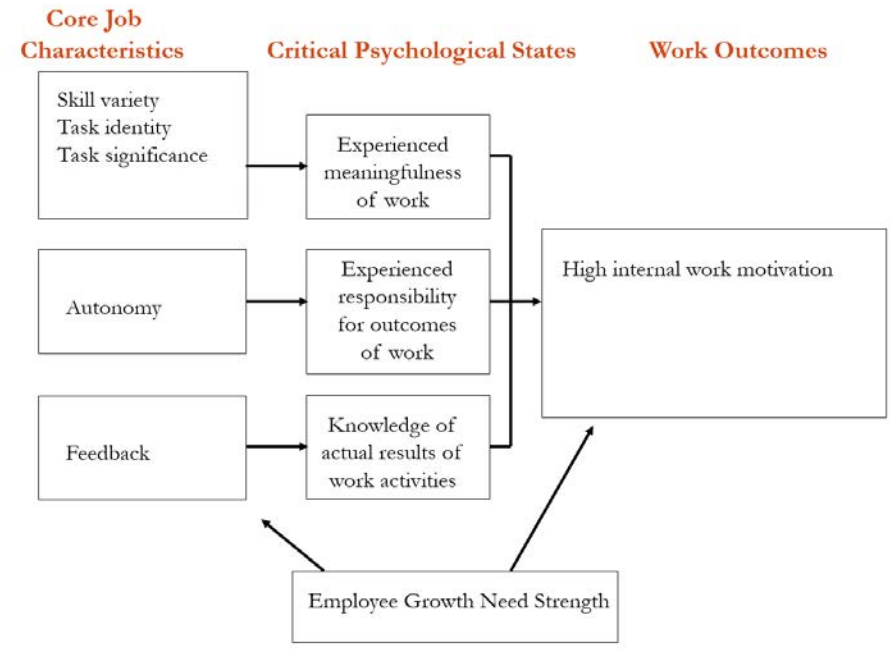
Source: Excerpts from Gross (2015[27]).

The results and conclusions of experiments such as those conducted by Ariely and Grant are consistent with theories linking job characteristics to work outcomes such as motivation and performance through psychological states such as the experience of meaningfulness at work. Hackman and Oldham's (1976[28]) Job Characteristics Model specifies the precise nature of these relationships. As shown in Figure 2.3, the Job Characteristics Model asserts that high internal work motivation, effective performance, and other desirable work outcomes such as high satisfaction, low absenteeism, and low turnover will result to the extent that workers experience three critical psychological states: (a) meaningfulness of work; (b) responsibility for the outcomes of work; and (c) knowledge of the actual results of work activities.

The question, then, becomes: Under what conditions will workers experience these desirable psychological states? The model posits that people working in jobs characterised by five core dimensions are most likely to experience the psychological states leading to high motivation and performance. Those five core job characteristics are: (a) skill variety, or the number of different abilities or skills needed to perform the work; (b) task identity, which is the degree to which a job requires completion of an entire function versus just a narrow piece of the larger whole; (c) task significance, which is the degree to which the job impacts others within our outside of the organisation; (d) autonomy, or freedom to choose how to schedule and carry out the work; and (e) feedback, or the degree to which the job itself offers information about the effectiveness of performance.

Consistent with findings from Ariely and Grant, designing or redesigning work to incorporate these five core job characteristics is expected to increase motivation and performance – assuming the person performing the work is reasonably high in "growth need strength" – that is, the desire for personal growth on the job. The model (as well as Ariely and Grant's research findings) is (are) less likely to hold true for workers with lower growth need strength, highlighting the fact that one size does not necessarily fit all when it comes to motivating or judging high performance. One practical aspect of the Job Characteristics Model is that it has generated a tool (the JDS; Job Diagnostic Survey) help quantify the motivating potential of any given job based on the five core job characteristics. This tool also includes a series of questions measuring workers' growth needs strength.

Figure 2.3. Job characteristics model



Source: Produced from Hackman and Oldham (1976[28]).

"Physician report cards have been found to promote patient safety because they prompt physicians to compare their professional conduct to that of their peers and trigger such internal noneconomic rewards as professional pride and the pleasure of helping others" notes Guszcza (2015, p. 70[9])) upon summarising a study carried out by health economist Jonathan Kolstad at the Wharton School of Business. Though economists and psychologists sometimes phrase things a little differently, they are often focusing on the same concepts: this workplace intervention in the health sector arguably works by heightening perceptions of "task significance" and "feedback," in the parlance of the Job Characteristics Model.

At minimum, psychological theories pertaining to intrinsic motivation such as those described above can be helpful in organising when and why different nudge tactics used by behavioural economists work. Better yet, such theories can prompt ideas for new nudges to be tested. "There is nothing so practical as a good theory," Kurt Lewin (1951[29]) has famously stated. Theories such as those described above and elsewhere in this paper can be useful during both the diagnosis and design phases of an organisational nudge initiative.

This leads to the question: How might the preceding theories be applied to improve the behaviour of organisations? Perhaps the initial, broad question to ask during the diagnostic phase of inquiry is whether intra or inter-institutional barriers are stifling or fostering intrinsic motivation. Traditional application of Job Characteristics Theory entails redesigning (i.e., enriching) jobs to make them more motivating, thereby improving performance. These traditional applications are of limited utility in a complex environment, in which there is limited control over job design and incentives. Nevertheless, the middle section of the Job Characteristics Model is worth reflecting on. To what degree might policies governing the planning, implementation, and monitoring of various programmes be facilitating or thwarting the experience of the three critical psychological states? For example, are those implementing the projects allowed sufficient autonomy to organize the work in a way that makes sense in their context? Are communications in place to ensure workers know throughout the process whether or not they are performing well and meeting expectations? Do those working on a project see the connection between what they are doing and the broader objective (task significance)? Some of these issues may need to be addressed at the unit or workgroup level by a leader, but others could possibly be addressed through a larger scale intervention.

3. Goal-setting is an important motivational tool

Goal setting theory (Locke and Latham, 1990[30]) has perhaps been the most useful theory of motivation for I-O psychologists (Spector, 2012[31]). This theory has been widely used in organisations and well-supported by research. The theory holds that not all goals are equally motivating. In order for goals to improve job performance, four factors must be present. The goals must be a) challenging; b) specific; c) accepted by the worker; and d) accompanied by feedback on progress toward the goals (Locke and Henne, 1986[32]). Goal acceptance and buy-in by workers can be achieved by allowing workers some voice in the goal-setting process, by tailoring goals to workers' needs and interests, and/or by an effective leader who inspires goal acceptance.

At a basic psychological level, goal setting is believed to exert its motivating effects through a discrepancy reduction process whereby workers seek to reduce undesirable goal-performance discrepancies in order to receive a positive self-evaluation (Nicklin and Williams, 2011[33]). Goal setting theory overlaps with and is supported by techniques familiar to behavioural economists, such as commitment devices and implementation intentions, described in Shephard (2017[21]). Such techniques can help bolster both goal specificity and buy-in via active engagement in the process of translating goals into concrete action steps.

A fundamental decision in any organisation is the extent to which goals should be set at the individual, subgroup, unit, or organisational level. The success of team competitions at work suggest that group goals can indeed work, as competitions themselves are often goal-setting interventions even if not labelled as such. For example, the example from South Africa described in OECD (2017[1]) showed the effectiveness of setting team-based health-related goals (e.g., weight loss) among government co-workers. Interestingly, this intervention included timely feedback via pedometers which showed the number of steps each team took, presumably on a daily basis. Though social loafing in such a context is possible, it is less likely to occur if the motivational elements of goal-setting are in place (e.g., goal acceptance, feedback, etc.). "Few individuals will want to be the one who ruins the performance of their team," reasons Guszcza (2015[9]), p. 75) after describing a hospital intervention designed to increase handwashing among healthcare workers. Using an electronic soap dispenser equipped with a computer chip that records how often members of different hospital wards wash their hands, the intervention compared each ward's actual handwashing to standards (i.e., goal) set by the World Health Organisation.

4. Performance management requires good feedback, which necessitates good data

As suggested on the preceding pages (Job Characteristics Theory, Goal Setting Theory) timely feedback is critical to performance management. There are several behavioural barriers to high-quality feedback that can be overcome if understood. These barriers are both cognitive and social in nature. Cognitive barriers refer to the fact that heuristics and other shortcomings in our ability to take in, process, and recall information limit the accuracy of our assessments when judging others' performance. The halo (or horns) effect occurs when raters' perceptions of various aspects of performance are unduly influenced by their positive (or negative) perception of one aspect of performance: Raters or judges place too much weight on one aspect of performance and allow it to shape how they view performance quality overall, and on other dimensions. The confirmation bias is the very human tendency to seek out and remember information that confirms a previously held hypothesis or hunch. This causes our theories of other people's performance to shape how we notice, remember, and judge their performance quality later on. The recency effect is our tendency to place greater weight on recent behaviour when judging someone else's performance. These are a few examples of the very human limitations in the way we process information, which can stifle accurate performance assessments needed for high-quality feedback and performance management.

Shephard (in progress) provides examples of how behavioural insights can be applied to help overcome these barriers and improve accuracy. Recent advances in computing, including "the internet of things" creates additional, new opportunities to track certain performance metrics digitally. Of course, doing so

requires attention to the circumstances under which such tracking does and does not threaten workers' sense of autonomy and control, as research tells us that motivation and performance can suffer when such needs are threatened. As discussed later, electronic performance monitoring using real-time data may also require solutions from data science, including data visualisation techniques, to help decision makers make sense of the large volume of data that can be produced.

Regardless of whether performance judgments are based on cognitive retrieval, electronic performance monitoring, or some combination thereof, high-quality performance data is just part of the challenge. The other part is communicating feedback to the workforce. To be maximally useful, feedback should be frequent, constructive, specific, and behavioural in nature, helping the workforce see precisely what types of actions should be discontinued, continued, or increased.

One barrier to the delivery of effective performance feedback is the present bias, well-known to behavioural economists. The benefits of providing performance feedback (and developing others, more generally) are seldom immediately realised. Managers taking the time out of their busy schedules to provide feedback rarely see improvements right away, as behavioural change takes time and effort. Couple that with the fact that delivering feedback is often socially uncomfortable for all involved, and the present bias sets in: People will tend to favour gains (more time, interpersonal harmony) now, preferring them to larger payoffs in the future (better-performing employees). Understanding this barrier to feedback delivery and performance management is important to addressing it.

5. Not every performance problem is a motivational problem

The most highly motivated workforce in the world will fail to produce results if they do not have the skills needed for the job. For example, poor administrative capacity could be a result, in part, of a lack of skills.

I-O psychology has a long history of developing and testing interventions to ensure fit between the Knowledge, Skills, Abilities, and Other Characteristics (KSAOs) required of a work assignment and the KSAOs possessed by the staff tasked with completing the assignment. These interventions typically entail tweaks to the organisational hiring process, training, or both.

Either way, the solution commonly entails job analysis early in the process. This approach was recently highlighted by Google in its analysis of best practice case studies describing "real stories of organisations using data to make work better (re:Work, n.d.[34]). The case study in question describes performance problems among JetBlue's call centre employees. The method used to address this problem included a job analysis which required participation from subject matter experts at the organisation, and which resulted in a delineation of KSAOs important for the job, sorted into those needed at the point of hire versus those that could be learnt through training. JetBlue then developed and tested the introduction of a simulation to screen applicants on the KSAOs needed at the point of hire, which led to positive results; for example, training failure-based attrition fell by 75%, and overall training attrition fell by 25%.

In some organisational contexts, training is a more appropriate point of intervention than hiring to ensure workers have the requisite knowledge and skills. A model for successful employee training programs includes five steps: assess training needs at the organisational, task, and person levels; establish training objectives; develop and test training materials; implement the training program; and evaluate the training program often using an experimental or quasi-experimental design that compares the performance of workers who have and have not undergone the training program. Measuring actual job performance after training is important, as it is possible for skills adequately mastered in training to fail to transfer to the work setting for a variety reasons unrelated to skill acquisition but instead related to the worker and the work environment (Baldwin and Ford, 1988[35]).

Interventions such as job analysis, hiring, and training may admittedly be outside of the control of the complex network of entities involved in the planning, implementation, and monitoring of programmes. However, there is value in thinking through what KSAOs are needed for sufficient administrative capacity

to be achieved, and whether additional policies or supports can be put into place to help assure those KSAOs.

A recent case study from the Republic of South Africa is worth highlighting, as it demonstrates applications of I-O psychology in general and job analysis in particular to large-scale national development projects. As part of the country's long-term national infrastructure plan established in 2012, South Africa identified 18 major technology and infrastructure projects, known as SIPs (Strategic Integrated Projects) that would be prioritised in the days and years to come. The 18 SIPS include projects spanning a wide range of economic sectors and all nine provinces of the country. Efforts to skill South Africans for and through SIPs begged the question: What KSAOs are needed to accomplish these projects? Experts in South Africa carefully identified the occupations needed to accomplish the SIPs, using South Africa's Organising Framework for Occupations (OFO). From there, two individuals with I-O psychology expertise were enlisted to conduct a proof-of-concept study to identify the KSAOs needed within and across the SIPs – information that can help drive future education and training curricula (Gloss and Foster, 2014[36]). This was accomplished via a crosswalk between South Africa's OFO and the United States Occupational Information Network (O*NET) – a large database providing job analysis data on more than 900 occupations in the U.S. economy. I-O psychologists were involved in the conceptualisation of O*NET and continue to be involved in populating it, as each occupation is described in detail by hundreds of data points generated by job incumbents, subject matter experts, and job analysts. In the end, a detailed picture of the KSAOs needed to accomplish the 18 SIPs was provided. A limitation of this study was that it relied on U.S. data (KSAOs) instead of job analysis data from South Africa.

6. A positive work cycle can be strategically created by aligning individual and organisational goals

An overarching message pervading many traditional BI interventions is this: Desired decisions and behaviours are much more likely when programs and policies are set up in a way that is consistent with people's self-interests. Getting people to persistently act against their own near-term interests is difficult to do. This principle is every bit as true at work as it is outside of work. Accordingly, strategically designing work environments and jobs in ways that align individual and organisational goals has the potential to create win-win situations whereby individual and organisational growth occur in tandem, and work motivation is sustained over time.

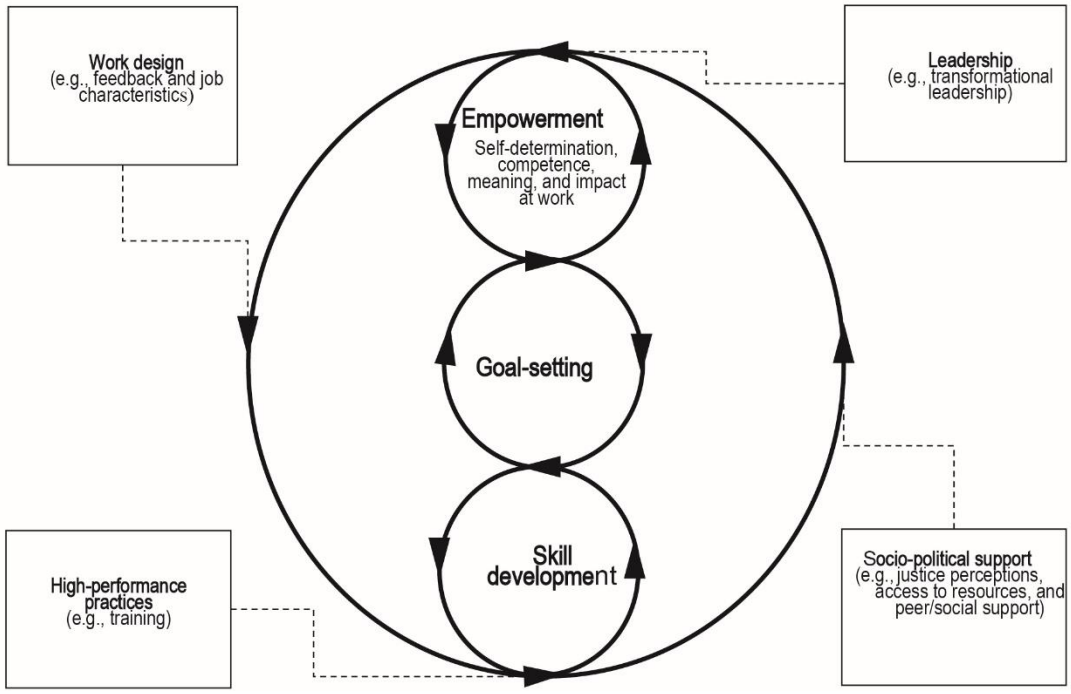
In 2014, the United Nations Istanbul International Center for the Private Sector in Development enlisted a multicultural team of I-O psychologists to provide input on how principles from the psychology of work could inform the role of the private sector in inclusive development. The resulting model was a Positive Work Cycle, shown in Figure 2.4, and presented in the culminating meeting in Istanbul attended by UN officials and Nobel Prize winning economist Joseph Stiglitz in late 2014.

As shown in Figure 2.4, the Positive Work Cycle requires attention not only to individual workers' goals, but also to job design, leadership, human resource practices, and the socio-political context in which the work occurs (Bhawuk et al., 2014[37]). It brings together many of the concepts discussed on the preceding pages (self-determination theory, goal setting, feedback, leadership, training, etc.) and illustrates their reciprocal relationship with each other and the broader environment in which work occurs. Bhawuk et al. (2014[37]) scholarships highlights "that poverty can be reduced, or perpetuated and worsened, through cycles of behaviour in the workplace which are greatly influenced by organisational and societal context. In particular, [the authors] highlight a "positive work cycle" that can lead to both greater productivity and well-being. At the heart of this cycle is the setting of challenging and specific goals and the realisation that people are powerfully motivated by the need to fulfil certain fundamental psychological needs. When this positive cycle is broken or reverses due to poor working conditions or unfair working arrangements, or when it does not start due to unemployment, people can be further disempowered, their skills can atrophy, and ultimately, they are likely to remain trapped in poverty. When this cycle is in operation, people are

empowered to shape their own destinies and the destinies of their communities and nations" (Bhawuk et al., 2014, p. 64[37]).

An open question is how and whether the Positive Work Cycle may be useful to help understand the skill deficits and to diagnose "pain points" and behavioural levers relevant to government policy and programmes amid the complex system of implementation, management and control at the national and sub-national levels, and even sometimes supra-national levels (for example, the EU).

Figure 2.4. The positive work cycle



Source: Bhawuk et al., (2014[37]).

7. Data drives better decisions at work. Data science can help

Data science and behavioural science can and need to work more closely together to maximize the potential to nudge organisations through behavioural insights. This has started to happen, but the full potential of this integration has yet to be realised.

Psychologist Michal Kosinki recently testified before the United States Equal Employment Opportunity Commission on the implications of "big data" for equal employment opportunity (Kosinski, 2016[38]). In his testimony, Kosinski describes how, if used properly, advances in data science can be used to identify talent and improve person-job fit. Big data can be used for other purposes as well. James Guszcza's 2015 article describes a variety of ways in which data science and behavioural science can work together to solve the last-mile problem. As Guszcza (2015[9]) points out, "much of what we call 'big data' is in fact *behavioral* data" (p. 73).

Recall the define-diagnose-design-evaluate framework for behavioural nudges shown in Figure 2.1. Big data has the potential to facilitate multiple points in this process. First, as problem sets are being defined, techniques from data science can provide a clearer picture of the organisational "state of play." By identifying behavioural patterns revealed in big data, organisations will be able to identify areas at risk for poor performance, such as providing early indicator that a project is lagging behind schedule or otherwise off track. This could allow for more laser-like, strategically aimed nudges in areas most in need of attention.

Big data can facilitate the design of behavioural interventions in at least two ways. First, it can enable the application of "smart nudges" that are tailored to the individual or population in question. Rather than using a "one size fits all" approach, the presentation or nature of the nudge could be adapted based on the needs, strengths, motivations, and shortcomings of the worker, unit, or project in question. Second, we have seen that performance feedback is an intervention in and of itself. If organised and presented in a way that makes sense to end users, big data can be an important source of feedback for individual workers as well as organisational decision makers. Early forays into this territory were described earlier – for example, providing people with immediate feedback on their work group's exercise or handwashing behaviours.

Finally, it should be noted that big data can serve as important criteria when evaluating behavioural interventions. At present, obtaining the data needed to evaluate behavioural interventions can be very challenging, as many behaviours are not readily observed or measured, and organisations do not always have the resources to track employee behaviours in a way that is useful to behavioural scientists. With digital metrics in place, the behavioural scientist may obtain a detailed picture of moment-to-moment work outcomes of interest.

Of course, big data also implies electronic monitoring of sorts. As suggested earlier, implementation of such monitoring needs to be balanced with concerns over privacy and the potential loss of autonomy or control perceived by workers who are tracked. The social facilitation effect well known to psychologists suggests that our performance of difficult tasks deteriorates in the presence of others. Research should examine whether and under what conditions electronic performance monitoring produces similar effects, and investigate ways to ensure big data are collected in a non-threatening, non-invasive way.

8. Small wins are important

As suggested in this chapter, there is no single, simple prescription for how to nudge organisational behaviour. This is especially true for institutions characterised by a complex set of actors working independently and collectively to accomplish innovative development goals. Under such circumstances, it is easy, and very human, to get overwhelmed into inaction given the scale and scope of the challenge at hand. As Weick (1984[39]) pointed out many years ago, "The massive scale on which social problems are conceived precludes innovative action because bounded rationality is exceeded and dysfunctional levels of arousal are induced" (p. 40). Weick relates this to the Yerkes-Dodson law, whereby an inverted-U-shape characterizes the relationship between stress (arousal) and performance: More arousal leads to better performance up to a point, at which the stress begins to have a negative effect. Weick proposes a solution to this problem, noting that "Reformulations of social issues as mere problems allows for a strategy of small wins wherein a series of concrete, complete outcomes of moderate importance build a pattern that attracts allies and deters opponents. The strategy of small wins incorporates sound psychology and is sensitive to the pragmatics of policymaking" (p. 40).

Weick's advice can be applied internally, to those charged with effecting change through the application of behavioural insights. Maya Shankar (2016[40]) outlined four principles contributing to the success of the White House Social and Behavioural Sciences Team's approach to changing behaviour in a U.S. policy context. These principles included:

1. Convert interest into impact.
2. Quantify your wins.
3. Celebrate small wins.
4. The importance of generating buy-in.

Note

[1] This seminar is part of a five-part seminar series in the context of an EC-OECD project "Designing better economic development policies for regions and cities". Other sessions in the series addressed the use of: contracts for flexibility/adaptability, performance indicators, financial instruments, and insights from behavioural science. The outcome of the seminars supports the work of the Regional Development Policy Committee and its mandate to promote the design and implementation of policies that are adapted to the relevant territorial scales or geographies, and that focus on the main factors that sustain the competitive advantages of regions and cities. The seminars also support the Directorate-General for Regional and Urban Policy (DG REGIO) of the European Commission in the preparation of the impact assessment for the post-2020 legislative proposals and to support broader discussion with stakeholders on the future direction of the delivery mechanisms of regional policy. Full details, including original papers and the resulting OECD publication summarising this work can be found at: https://www.oecd.org/governance/rethinking-regional-development-policy-making-9789264293014-en.htm

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3 How behavioural insights can help foster a culture of safety

This chapter presents the scoping work compiled at the beginning of the safety culture project. This is based on a desk review of academic and policy/practitioner literature and examines the behavioural and organisational barriers, scopes indicators used to measure changes with these barriers, and identifies potential areas for testing and experimentation with behaviourally-informed solutions.

The previous chapter argued that BI can be successfully expanded from influencing individual decision making to influencing organisational decision making via the individuals within them. This includes the organisational policies and procedures set in place that influence individual decisions. Similarly, culture influences the decisions and behaviours of people in an organisation, and these behaviours ultimately drive safety outcomes and performance. As will be discussed in this chapter, human and organisational factors are related to culture, though there is no clear conclusions and often additional research is suggested. This provides a logical avenue for the application of BI to add value. It is for this reason that culture, and in particular safety culture in the energy sector, was chosen as an avenue for testing the application of BI to changing organisational behaviour.

Safety culture, or lack thereof, has had a real and recent impact on society. There is clear evidence from an analysis of global incidents that safety culture is – at least in part – a key factor in most high consequence accidents, such as the nuclear safety system failure at the Fukushima Daiichi plant in Japan in 2011 (OECD/NEA, 2013[1]), and organisational and cultural lapses that contributed to the BP Deepwater Horizon oil spill in 2010 (Reader and O'Connor, 2014[2]); (Corkindale, 2010[3]). Just as significantly, many smaller and more frequent accidents can important as well as major incidents are usually the product of simple (i.e. minor) decisions or behaviours and system complexity. Safety culture is about changing these simple decisions and behaviours to prevent incidents (both minor and major).

Prevention of incidents like these strongly supports further research on safety culture and action in order for regulators to better serve the public interest. Regulators have a role to play in advancing safety culture across the industries that they oversee. A key aspect of this duty requires them to lead the way by understanding their own organisational cultures and behaviours, their cultural strengths and vulnerabilities, and how these factors influence the broader safety and regulatory system. Equally important is to understand the cultural and organisational changes and behaviours of regulated entities and industry to ensure that a safety culture is effectively implemented and impact the sector as a whole.

This chapter builds off that work by presenting the scoping work compiled at the beginning of this safety culture project. This is based on a non-exhaustive desk review of the academic and policy/practitioner literature on developing safety oversight culture in regulatory agencies and a culture of safety compliance in regulated entities. The aims and objectives are as follows:

- To outline behavioural and organisational barriers to developing a regulator safety culture and a culture of safety compliance in regulated entities;
- To scope the existence of indicators in regulator safety oversight culture, strengths and weaknesses and the methodology to derive the indicators; and
- To identify potential areas for testing and experimentation of behaviourally-informed solutions aimed at developing a culture of safety within regulators and regulated entities.

The first section outlines findings from academic and practitioner literature reviews on organisational barriers to developing a safety culture, as well as indicators used to measure changes associated with these barriers and/or removing them. The second section describes how the findings from the literature reviews can be used to test behavioural insights in real world policy and regulatory contexts.

Academic and practitioner literature

There exists a significant amount of academic and practitioner work addressing the role of safety culture in high risk industries. This section provides an overview of literature assessing organisational and behavioural barriers to developing a safety culture, along with an overview of safety culture indicators. The scoping work is an initial scan and was built upon iteratively as the project moved forward.

Understanding safety culture and associated challenges

The following paragraphs provide an overarching understanding of safety culture as well as reasons as to why and when it can be difficult to foster. They outline the key organisational and behavioural barriers, in addition to an overview of indicators used to measure safety culture.

There is no concise internationally agreed upon definition of 'safety culture'. However, at its core, safety culture is an aspect of the larger organisational culture, including the organisation's values, beliefs, attitudes, norms and practices (TRB, 2016[4]) (Cooper, 2002[5]). In the literature, there is a clear understanding that safety culture impacts safety performance (Smith, Emma and Wadsworth, 2009[6]). For instance, one study analysed 15 major petrochemical accidents between 1980 and 2010 noted that poor safety culture contributed to 12 of the 15 accidents (Fleming and Scott, 2012[7]).

It is widely acknowledged that regulators have an important role in promoting safety culture. However, responsibility also lies with the industries in combination with regulators to promote a safety culture, acknowledging limits of regulation and that regulators cannot create a safety culture on their own (TRB, 2016[4]).

A recent review acknowledged that there are common sets of practices and processes across the different conceptualisations (TRB, 2016[4]). It found that the elements described by the US Bureau of Safety and Environmental Enforcement mirror those identified in major academic reviews of safety culture research, as well as leading frameworks in different industries. The elements are as follows (BSEE, 2013[8]):

1. leadership commitment safety values and actions;
2. hazard identification and risk management;
3. personal accountability;
4. work processes;
5. continuous improvement;
6. environment for raising concerns;
7. effective safety and environmental communication;
8. respectful work environment; and
9. enquiring attitude.

To provide another framework for comparison, the following elements were generated by a review using similar methods, although collapsed into fewer categories (NEB, 2017[9]). The dimensions include:

1. safety leadership commitment;
2. vigilance;
3. empowerment and accountability; and
4. resiliency.

Organisational barriers and enablers to a strong safety culture

There are a number of characteristics of high risk industries which makes it challenging to measure safety culture. These aspects include an understanding of what at times can be an unclear concept of safety culture (Cooper, 2002[10]), employers being unaware of issues, a myriad of influencing/reciprocal factors (personal commitment, perceived risk, competencies, safety knowledge, job satisfaction, etc.) and challenges in measurement. Additionally, there are often challenges at an organisational level, in terms of understanding and receiving feedback (TRB, 2016[4]).

Elements of strong safety culture are described below and discussed briefly in terms of ways in which there may be barriers and enablers to strong safety culture. The descriptions are derived largely from a recent reviews (TRB, 2016[4]) (NEB, 2017[9]). This is a not intended to be a definitive summary, but to help frame discussions with regulators. The barriers and enablers below were categorised according to initial discussions with country representatives

Barriers

1. **Production pressure**: An organisation's primary goals (e.g., production) compete or may be perceived as competing with safety (Carroll and Edmondson, 2002[11]); (NEB, 2014[12]). Strategies to combat these opposing incentives are addressed through leadership prioritising strengthening safety culture and critical thinking which are both vital to the maintenance of a dynamic safety culture (Berglund, 2016[13]). Presenting awards to 'champions' acknowledging strong safety culture is another way to potentially ameliorate this issue (TRB, 2016[4]).
2. **Personal accountability** and **enquiring attitude:** A strong safety culture depends on employees' readiness to reveal errors and near misses, and to share their ideas and concerns to more senior people (Carroll, 2002; Stern, 2008; (Tangirala and Ramanujam, 2008[14]). When the right conditions are present, speaking up and listening have an impact on safety and reflect a strong safety culture. (TRB, 2016[4]).
3. **Hazard identification and risk management:** Accurate hazard identification and risk management can result from pooling diverse viewpoints (Weick and Westley, 1996[15]). In particular, storytelling can be used to address gaps and inconsistencies that pose threats to safety (Weick and Browning, 1986[16]). Also important is mindful organising which is an enquiring attitude concentrated on hazard identification, risk management and personal accountability (TRB, 2016[4]).
4. **Work processes:** Work processes are key to strong safety culture and yet challenging because they often involve substantial resource commitments, such as equipment and training. Building workforce knowledge, skills, and abilities has been demonstrated to foster safety culture and safety performance (TRB, 2016[4]).
5. **Organisational changes and leadership:** Top-processes – such as management, existing safety systems, etc. – have an influence on safety culture. When organisational management changes or leadership fails to uphold these standards, safety culture can be affected. Organisations may have long standing records of safety and risk management that could come under pressure when changes happen at the organisational or management level. This was seen as a contributing factor to Deepwater Horizon (Reader and O'Connor, 2014[2]); (Corkindale, 2010[3]).

Enablers

1. **Leadership commitment safety values and actions:** Leader commitment to safety (such as through safety practices and procedures), the priority they place on safety compared to other goals, and their dissemination of safety information impacts employee views on safety (Katz-Navon, Naveh and Stern, 2005[17]); (NEB, 2014[12]). It is more likely that employees will focus on safety when leaders isolate and give attention to it (TRB, 2016[4]).
2. **Respectful work environment:** Certain ways of working can increase focus on safety and foster a respectful work environment and the ability to raise safety concerns without fear of disciplinary action. Particularly key are safety rounds, or visits by leaders of front-line facilities to talk about safety issues and concerns (Singer and Tucker, 2014[18]). (TRB, 2016[4]).
3. **Atmosphere for raising concerns**: Academic literature describes a key way in which leaders empower employees to raise concerns – by creating psychological safety, or the belief that it is safe to take interpersonal risks (Edmondson, 1999[19]). An empowering leader enables employees

to think, speak up and learn by doing (Yun, Faraj and Sims, 2005[20]); (Ely and Meyerson, 2010[21]) (TRB, 2016[4]).

4. **Effective safety and situational communication:** Employees are more likely to report errors and incidents when leaders make safety a priority and adequately disseminate safety information (Naveh, Katz-Navon and Stern, 2006[22]), (Weingart et al., 2004[23]). On the other hand, employees deviate from safety procedures and do not speak up when they see unsafe activity, when there is a poor safety climate (e.g., one in which there is high production pressure, and not a great deal of widely disseminated safety material) (Hofmann and Stetzer, 1996[24]); (TRB, 2016[4]).
5. **Continuous improvement**: involves exerting constant effort to identify often understated details. 'After event reviews' (AERs) have been shown to be a helpful practice. They are guided discussions of past experience leading to an understanding of the causes of failures and successes, and lessons learned for improvement (Popper and Lipshitz, 1998[25]); (Ellis and Davidi, 2005[26]); (TRB, 2016[4]). This is further enshrined in the *OECD Recommendation of the Council on the Governance of Critical Risks*, which encourages the continuous sharing of knowledge including lessons learned from previous events, research and science through post-event reviews, to evaluate the effectiveness of prevention and preparedness activities, as well as response and recovery (OECD, 2014[27]). A culture for continuous improvement goes hand in hand with the concept of psychological safety – the belief that one will not be punished or humiliated for speaking up with ideas, questions, concerns, or mistakes (Edmondson and Lei, 2014[28]).

The barriers and enablers presented above provide an overview from the perspective of mainly one framework (BSEE, 2013[29]) and are adapted from a review (TRB, 2016[4]). It is worth mentioning that when assessing safety culture in a variety of contexts, the way in which other frameworks are organised may be more useful in isolating behaviours, as well as identifying barriers and enablers to that behaviour. For example, another way to think about these elements is to arrange them in terms of "cultural threats" (production pressure, complacency, normalisation of deviance) and "cultural defences" (committed safety leadership, vigilance, empowerment and accountability, resiliency) (NEB, 2014[12]).

What works and what can regulators do to promote safety culture

Regarding what works to promote safety culture, the academic literature addresses conceptual underpinnings of behaviour and safety. In general, reviews cite complexity and that culture cannot be shaped overnight and the importance of shared responsibility between regulators and industries (Swiss Federal Nuclear Safety Inspectorate (ENSI), 2015[30]).

The literature looks at the role of human and organisational factors in promoting safety and suggests research to understand in a detailed context specific manner. Differences in safety culture in certain industries across cultures have been explored and the importance of understanding practical lessons learned across industries is acknowledged. These findings about behaviour and importance of context provide an opportune opening for the use of behavioural insights to add value.

Considering the importance of behaviour, the previous section aimed to outline some of the key ways in which barriers and enablers to strong safety culture can be addressed using evidence from the literature. Building upon this, select high level recommendations for regulators that have come out of reviews of evidence, include creating memoranda of understanding around safety culture, safety culture champions, and assessment and improvement of safety culture using safety management principles (TRB, 2016[4]).

With respect to the oil and gas industry, a recent comprehensive study based on an extensive literature review as well as interviews with oil and gas executives and regulators assessed how a regulator's culture influences safety outcomes in high hazard industries. It identified "six cultural vulnerabilities" that require control: a politicised mission, a punitive culture, the presence of bureaucratic inertia, the tolerance of inadequate capacity and competency, compliance mentality and a preoccupation with active failures

(Bradley, 2017[31]). The work also highlighted 'six cultural strengths' that require nurturing: the presence of leadership and political independence, a learning culture, innovation, technical excellence, risk consciousness and systems thinking (Bradley, 2017[31]). These are areas to keep in mind when thinking about promoting safety culture from a regulator point of view.

Additionally, a review carried out by the nuclear power regulator in Switzerland on safety and oversight culture highlights important areas of focus including competence and professionalism, overarching collaboration and framework for oversight. In assessing oversight the study mentions key challenges including active involvement of staff, confidentiality in handling data and results, experiences with respect to project organisation and project management (Swiss Federal Nuclear Safety Inspectorate (ENSI), 2015[30]).

This section provides background information on the elements of safety culture as well as what the literature indicates are good ways of improving upon each of the elements. It also addressed some recommendations of what works, as well as lessons learnt for regulators in specific industry contexts.[1] The following section provides practical examples of where barriers to strong safety culture resulted in failures.

Safety culture lessons learnt from incidents

Documents addressing lessons learnt from failures provide important details and nuances. Examples of such reports include debriefs on lessons learnt from the Fukushima nuclear accident (OECD/NEA, 2013[32]); (INPO, 2012[33]); (NRSB, 2014[34]) and the *Deepwater Horizon* oil spill (NAE and NRC, 2011[35]) in the Gulf of Mexico. This section addresses some of the major implications for understanding the promotion of a culture of safety in high risk industries illustrating the concepts through practical examples.

Fukushima Daiichi Nuclear Accident

On March 11, 2011, an earthquake occurred on Japan's main island which knocked out power to the Fukushima Daiichi plant, and then a tsunami inundated portions of the plant site. Flooding of critical plant equipment resulted in the extended loss of power, with the consequent loss of reactor monitoring, control and cooling functions in multiple units. The accident prompted widespread evacuations of local populations and subsequent distress, large economic losses and the eventual shutdown of all nuclear power plants in Japan (National Research Council, 2014[36]).

Since this incident, a significant number of reports have been published gathering lessons learnt, for Japan, as well as for other countries. It is important to note that these reports address a range of areas of findings, however, in this review, only the role of safety culture and compliance in the disaster will be discussed (INPO, 2012[33]).

Prior to the incident, the Japanese regulator put a number of measures in place which were found to have led to strengthening of nuclear safety culture. These included: "alert" reports which were issued to share safety culture implications learnt from events; each year a safety seminar was held; an employee safety culture survey was conducted annually; and the chief reactor engineer on each site provided an annual assessment on the state of safety culture. It is acknowledged that these as well as other actions served to strengthen nuclear safety culture.

Although effort was put forward to promote a safety culture, failures ultimately occurred. A few of the key safety culture lessons learnt are addressed below.

- As described above, safety culture is about cultivating a questioning attitude and challenging assumptions. It was found that the regulator would have greatly benefited from doing this (i.e. by believing that a large tsunami could even occur). An important element to consider here is how to avoid 'group think' (INPO, 2012[33]). Some solutions for groupthink include incorporating scenario planning – even for 'black swan' events, such as a tsunami – paying attention to

information/intelligence, creating an atmosphere that minimises self-censorship, paying attention to dissenting views, being vigilent of "mindguards" (bottlenecks in the flow of information), being ready to be wrong and not ridiculing dissent. However, research is mixed and care needs to be taken when assessing aspect of cultivating a questioning attitude and challenging assumptions.

- The accident went beyond safety experience. Emergency response personnel did not have the procedures, equipment and training needed. It is acknowledged that international learning would have been important as senior managers indicated that knowing about lessons learnt in other contexts in advance would have greatly helped. Going forward regulatory authorities should consider including in their guidance both prevention and mitigation measures at each level (OECD/NEA, 2013[32]).
- Organisational factors, including the independence, technical capability and transparency of the regulator in Japan were found to have contributed to the accident and the emergency response challenges confronted (OECD/NEA, 2013[32]); (National Research Council, 2014[36]).

Deepwater Horizon oil spill in the Gulf of Mexico

On 10 April 2010 an explosion occurred on the *Deepwater Horizon* Drill Rig resulting in an uncontrolled oil release of 4.9 million barrels into the Gulf of Mexico. It was eventually capped on 15 July 2010, however, the oil spread through the adjacent waters, shorelines and lands – areas where ecological health is critical to the economic wellbeing of the neighbouring communities (OEPC, 2010[37]).

A key safety culture lesson from this incident is the importance of a deep understanding of organisational systems (from tools such as such as root-cause/first-cause analysis teams, incident reviews, and other forms of self-analysis, etc.). The absence of such practices for systematically and holistically assessing risk and managing identified hazards was associated with the incident (NAE and NRC, 2011[35]); (Reader and O'Connor, 2014[2]); (Corkindale, 2010[3]).

The following section discusses how to measure safety culture – a practically important element to all that has been discussed thus far.

Indicators used to measure safety culture

There are a number of ways to measure safety culture. The following section provides an overview of key challenges, methods as well as overall considerations to keep in mind when designing and measuring indicators of safety culture. Thinking about applying behavioural insights, a key initial consideration is an understanding of how to measure outcomes. Appreciating that context plays an important role in not only what is tested, but also how it is measured, this review gives an overview of potential methods to inform further work designing indicators for the right behaviour and context.

Challenges

Measuring safety culture can be challenging for a variety of reasons (Beukes, 2015[38]). Practically, it can be time consuming and the expertise needed to carry out technically sound analysis may not exist with current employees. It can be complex to weigh multiple factors simultaneously (i.e. person, behaviour and situation) and there may not be data to readily draw safety culture indicators. Additionally, it is important that there is trust in the results, and that they are used in a practical way.

Before dedicating time and effort to measuring safety culture, it is key to acknowledge why it is important to assess safety culture. Reviews of evidence have demonstrated that it should be completed for one of several reasons related to an organisation's strategic goals: to shift the discussion from the imprecise to the precise; to permit for the monitoring of progress; to give motivation and feedback (including communication); to recognise strengths, weaknesses and gaps, and potential improvements; and to offer

leading indicators (TRB, 2016[4]). When applying behavioural insights and determining how to test a principle, it is important to acknowledge not only which outcome measures are practical to assess and technically appropriate over the study period, but also that what is useful in the real world setting.

Methods

To measure safety culture, it is important to begin with a clear concept, and then determine a set of appropriate assessment procedures, including potentially both quantitative and qualitative methods. These will often vary based on organisation sizes, resources, and work activities (TRB, 2016[4]).

Each of these assessment methods has strengths and limitations (see reviews by (IAEA, 2002[39]); (Sackman, 2006[40]); (TRB, 2016[4])) and balance between practicality and accuracy, and scientific validity is important. Some of the methods commonly used to measure safety culture (TRB, 2016[4]) are as follows:

- Ethnography uses methods originally coming from field anthropologists to give understanding of underlying assumptions and meaning.
- Episodic field work includes a mixture of observation, interviews and document analysis.
- Safety culture and climate surveys give measurable ratings of cultural characteristics.
- Guided self-analysis involves cultural insiders analysing their own culture via workshops and/or meetings.
- Finally, multiple methods can be used to account for strengths and limitations of the other methods described above.

Considerations

It is important to reflect upon differences between leading and lagging indicators (Reiman and Pietikäinen, 2010[41]), process and outcome, as well as indicators intended for short-term and/or long-term use. It is acknowledged in the literature that cultural change can take a significant amount of time, and being able to collect data until a period of measurable change as well as to interpret accurately what it represents over time is important.

Practical application of behavioural insights

As discussed above, the field of behavioural insights is based centrally around how context shapes our decisions. It leverages powerful lessons from diverse academic disciplines such as psychology, economics and anthropology, and takes an evidence-based, rigorous methods approach. After isolating a specific behaviour to change, along with the barriers and triggers to that behaviour, next comes the application of behavioural insights concepts.

The diversity in application of behavioural insights is demonstrated in published policy works is highlighted by a recent review of case studies across OECD countries (OECD, 2017[42]). Although it is not an exhaustive list of how behavioural insights have been applied, this chapter addresses three main ways in which behavioural insights can and have been applied in policy settings: 1) literature review/behavioural lens; 2) lab/online experiment and 3) randomised controlled trial/field experiment.

1. *Literature review/behavioural lens:* The simplest and often least time-consuming application of behavioural insights is through a literature review/behavioural lens. Following a thorough understanding of the context around a certain behaviour, as well as the relevant policy and academic literature, behavioural insights may be applied and the impact measured. If using this technique, it may not be possible to know with a high degree of certainty whether the application(s) can be attributed to any observed changes in behaviour. It is worth noting that there are a number of other forms of assessment which may be beneficial to gaining an understanding in addition to

literature review. These include strategic reviews, needs assessments, process evaluations, business case assessments, etc. (Glennerster and Takavarasha, 2014[43]).

2. *Lab/online experiments:* Governments may be hesitant to scale a certain behaviourally-informed policy, potentially spending a significant amount of resources, without knowing for sure if will work in real world contexts. A lab/online experiment can be a way of testing behaviourally-informed interventions in a highly controlled environment to generate evidence. This methodology is often used when it is not possible to carry out more rigorous methods in the field (i.e. to randomise, as addressed in the next section), but a fundamental idea/concept would like to be tested. These methods are often used in marketing and psychology research
3. *Randomised controlled trials/field experiments:* Testing using a randomised controlled trial (RCT) in a field experiment allows for nuanced understanding of the complexities of context. Randomised controlled trials use a control group to compare the effectiveness of an intervention against what would have happened if nothing had changed/the intervention was not applied. RCTs are often attempted where possible. The methods involved are discussed in the next section, and the rest of the report.

Applying behavioural insights in practice

A major part of the value added of applying behavioural insights through literature reviews, lab/online experiments and/or RCTs is that the applications are part of a culture of experimentation and evaluation associated with the application of behavioural insights. In 2019, the OECD released a toolkit for applying BI from start to finish on any policy problem, which is centred on a systematic process to understand the root of the policy problem, gather evidence of what works and ultimately improve policy outcomes. This framework involves five steps that are abbreviated to "BASIC" (OECD, 2019[44]):

1. **B**ehaviour: Identifying and better understanding the behaviours driving the policy problem, and consider how these behaviours could be targeted given desired policy outcomes and context.
2. **A**nalysis: Examine the psychological and cognitive factors that are causing the targeted behaviours to identify the behavioural drivers of the problem. Complementary existing BI frameworks can be used to aid this analysis (see Box 3.1).
3. **S**trategy: Translate the analysis into behaviourally-informed strategies that could effectively change the behavioural problem.
4. **I**ntervention: Design and implement an intervention to test which strategies are most effective at addressing the behavioural problem.
5. **C**hange: Develop plans to scale what works into a full policy intervention, communicate what did not work for the community to learn and seek to sustain behaviour change over time.

Box 3.1. Some key BI frameworks

With the rise of BI around the world, a number of useful frameworks have been developed by both government and non-government agencies. Similar to ABCD, all of these frameworks use a simple mnemonic to establish an analytical tool aimed at helping a policymaker think about behavioural issues within a policy problem. While ABCD can be seen as "another framework", it was designed and optimised to be used as the analytical heart of the BASIC process framework rather than a standalone tool.

Below is a non-exhaustive list of widely referenced frameworks that complement ABCD and could be a resource for policymakers looking for different ways to analyse a behavioural problem.

- **MINDSPACE** (The Behavioural Insights Team, 2010): Provided an early checklist for thinking about how nine well-evidenced behavioural insights may inform public policy development, design and delivery.
- **Test, Learn, and Adapt** (The Behavioural Insights Team, 2013): Gave an accessible introduction to the basics of using randomised controlled trials in policy evaluation.
- **EAST** (The Behavioural Insights Team, 2013): Provided a simple framework considering how behavioural insights may help design policies based on leveraging convenience, social aspects of decision-making and the attractiveness and timeliness of policies.
- **World Development Report: Mind, Society, and Behavior** (World Bank, 2015): Gave a comprehensive overview of how the BI perspective on human decision-making is of relevance to development policy.
- **Define, Diagnose, Design, Test** (ideas42, 2017): Provided a practical framework for thinking through a problem and identifying behaviourally informed solutions.
- **US Internal Revenue Service Behavioral Insights Toolkit** (IRS, 2017): Created to be a practical resource for use by IRS employees and researchers who are looking to use BI in their work.
- **Assess, Aim, Action, Amend** (BEAR, 2018): Presented a playbook developed for applying BI in organisations outlining four steps for applying BI.

Note: Box originally created for (OECD, 2019[44]), Tools and Ethics for Applied Behavioural Insights: The BASIC Toolkit, OECD Publishing, Paris, https://doi.org/10.1787/9ea76a8f-en.
Source: The Behavioural Insights Team (2013[45]), Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials, https://38r8om2xjhhl25mw24492dir-wpengine.netdna-ssl.com/wp-content/uploads/2015/07/TLA-1906126.pdf (accessed on 6 November 2018); The Behavioural Insights Team (2010[46]), MINDSPACE, https://www.behaviouralinsights.co.uk/publications/mindspace/ (accessed on 6 November 2018); World Bank (2015[47]), The World Development Report 2015: Mind, Society and Behaviour, http://www.worldbank.org/content/dam/Worldbank/Publications/WDR/WDR%202015/WDR-2015-Full-Report.pdf (accessed on 6 November 2018); ideas42 (2017[48]), Define, Diagnose, Design, Test, http://www.ideas42.org/blog/first-step-towards-solution-beta-project/ (accessed on 6 November 2018); IRS (2017[49]), Behavioral Insights Toolkit, https://www.irs.gov/pub/irs-soi/17rpirsbehavioralinsights.pdf; BEAR (2018[50]), How Should Organisations Best Embed and Harness Behavioural Insights? A Playbook, http://www.rotman.utoronto.ca/-/media/Files/Programs-and-Areas/BEAR/White-Papers/BEAR_BIinOrgs.pdf?la=en (accessed on 6 November 2018).

Complementary fields of work

Although behavioural insights as a field can provide a great deal of understanding, data analytics and fields which take a deep dive perspective, such as qualitative research and design thinking, are likely to play an important role in facilitating, augmenting/strengthening and evaluating the impact of behavioural insights.

Criteria for a randomised controlled trial/main challenges with field experiments

Although on first glance, the theory behind conducting a randomised controlled trial may seem straightforward, a significant amount of effort and time is usually put into setting up field experiments. Simple things can become complex rather quickly. There are practical and logistical elements to consider, as well as a number of technical aspects that should be kept in mind. A few select challenges in carrying out field experiments are described below: 1) whether randomisation is possible; 2) managing challenges in the field; and 3) measuring outcomes.

- *Randomisation is possible:* A defining feature of RCTs is the ability to effectively and accurately randomise individuals into representative treatment and control groups. In achieving this, one can obtain understanding of how the treatment compares to doing nothing. Along with thinking about

the ability to randomise, sample size should be considered – there must be a large enough number of people in the sample to obtain statistically meaningful results (OECD, 2017[42]).

- *Manageable challenges in the field:* It is important to have a detailed understanding of the dynamic situation throughout the intervention period and to acknowledge meaningful confounding variables and threats to understanding and interpreting data. Careful attention should be paid to ensuring that there is not cross contamination between treatment and control arms. This may be a challenge especially if dealing with individuals working in close proximity in the same environment. Ensuring that an experiment is well designed and uses rigorous methods will lead to results worthy of publication – it is good practice to publish results to promote transparency and accountability.
- *Measurable outcomes:* As emphasised above, it is critical to collect meaningful outcome data. It is important to identify short-term and long-term effects, particularly when aiming to create sustained behaviour change and habit formation (OECD, 2017[42]).

Ethical considerations

Behavioural insights can be a powerful tool and it is therefore important to consider ethical implications around influencing behaviour change. As discussed in (OECD, 2019[44]), this is especially true as applying BI collects and uses data on individual and group behaviours, as well as uses experimental methods for testing theories of human behaviour. As a result, issues related to privacy, consent or the ethics of applying certain solutions to only some groups arise. (OECD, 2017[42]) reviews the application of BI across 60 government units and finds that, although ethical considerations are considered a challenge, ethics are not the most common opposition/criticism to applying behavioural insights ('scepticism on effectiveness and acceptability' are the most frequently cited).

Recognising the challenge of ethics and the lack of internationally recognised standard way of dealing with ethical implications of applying behavioural insights to policy, the BASIC toolkit includes a set of ethical guidelines for policymakers to follow to ensuring they are always "nudging for good". These guidelines are broken down by both pre-BI project as well as by each of the five stages of BASIC. Three generally principles to discuss and consider before starting a behaviourally-informed intervention are (OECD, 2019[44]):

- **Consider establishing an ethical review board from day one**. If time and resources do not allow it, then outline the ethical issues associated with the project, how to address them and continuously consider where ethical approval may be required. A university ethical review board may be considered for expert advice and the use of established ethical approval process can be used.
- **Appoint ethical supervision of data collection, use and storage**. BI often involves data collection and analysis that goes beyond what is standard in public policymaking. Consider appointing at least one member – either a member of the ethical review board or the team working on the behaviourally informed intervention – to supervise ethical aspects of data collection, use and storage.
- **Observe existing ethical guidelines and codes of conduct**. Make sure all team members observe ethical guidelines and codes of conduct, which are often already present in public institutions. Where existing standards are not sufficient for BI, flag these issues and establish procedures for these instances. Ensure appropriate procedures are in place to protect whistleblowing and ensure anonymity is respected.

Potential areas for testing and experimentation

The sections above outline the stages involved in applying behavioural insights in practice. It is first important to understand the context, define the behavioural problem(s), and then generate an analysis, set of strategies and interventions to test before scaling up what works into a policy for change. The following

section will draw upon the findings of the literature reviews as well as literature from published case studies applying behavioural insights in real world contexts to facilitate the identification of potential areas for testing and experimentation of behaviourally-informed solutions aimed at developing a culture of safety within regulators and regulated entities.

Stage 1: Behaviour – Identifying and defining the problem

The literature reviews above provide an understanding of certain organisational and behavioural barriers to creating a culture of safety. They help in potentially identifying specific behaviours to which behavioural insights could be applied, as well as barriers and triggers to such behaviours.

As described above, across high risk industries, key organisational barriers to a strong safety culture include: production pressure, lack of personal accountability and enquiring attitude, hazard identification and risk management and work processes. Key enablers of a strong safety culture include leadership commitment, respectful work environment, environment for raising concerns, effective safety and environmental communication and continuous improvement. These constitute specific behaviours that are likely to lead to a change in culture, as well as illustrate potential touchpoints where it is possible to influence the barriers and triggers to such behaviours.

Stage 2: Analysis – Understand why people act as they do

Given the importance of context in decision making and behaviour change, it is critical to have a detailed understanding of why people act as they do in the suspected areas for behavioural insights application.[2] In order to obtain this nuanced understanding, methods such as data analytics, site visits, qualitative research and design thinking can be used. This stage also involves looking at what has been achieved in relevant policies in other jurisdictions as well as the academic literature and conferring with academic experts. This step it critical to understanding whether specific behavioural insight(s) is/are applicable in a certain way, in a certain place and at a certain time. Although this report provides ideas and seed understanding, ultimately, this work will need to be done outside of this report to understand details.

Stage 3: Strategies – Identifying solutions for behaviour change

Once an understanding of the problem and the context is carried out, then strategies for effectively changing the problem can be identified. Although not a comprehensive list, the following behavioural insights principles draw upon certain barriers and triggers identified in the literature reviews and in discussion with country representatives, in this case both through the NER and with country contact points inside the regulatory authorities. The principles which may be relevant when thinking about designing behaviourally-informed policies to create a culture of safety are accompanied by examples of application in real world policy contexts (OECD, 2017[42]); (JPAL, 2017[51]); (ideas42, 2017[52]).

- *Social benchmarking/feedback*: comparing a person's behaviour to that of their peers. Showing doctors comparative prescription rates to their peers made them less likely to prescribe unnecessary medications (Behavioural Insights Team, 2015); household water consumption was reduced after receiving comparative information about usage by neighbours (ideas42); feedback comparing employees' walking habits to those of their colleagues encouraged them to walk more (University of Pennsylvania).
- *Communication of risk*: a trial analysed the most effective way to communicate risk information and motivate subsequent action related to safety of food borne illnesses (Social and Behavioural Sciences Team, 2015).
- Other areas for testing could include group think, availability cascades and risk regulation, choice architecture (default, anchoring), optimism bias/discounting, omission and status quo bias, authority bias and commitment, salience.

Behavioural insights concepts can be applied in isolation or in combination. It is important to note that if testing multiple concepts at the same time, it will not necessarily be possible to know the degree to which each behavioural insight was effective.

Another important point to consider in the design of the intervention is whether the behavioural insight will likely lead to a short-term or a long-term change, perhaps even habit formation. This has been discussed by a variety of academic studies and should be considered when designing the intervention and evaluation (Duhigg, 2012[53]). A recent paper outlines a number of reasons why applications of behavioural insights may fail. In addition to some nudges producing only short-term effects, the application of behavioural insights can produce confusion and compensating behaviour. To avoid these issues, it is important to be critical at all stages (Sunstein, 2017[54]).

Stage 4: Intervention – Testing strategies to inform public policy development

The next stage is to design and implement an intervention to test and evaluate the behavioural insights identified in Stage 3. How this is carried out is highly dependent on stages 1, 2 and 3, as well as resources available, in addition to what type of evaluation is technically and practically best suited for the context (i.e. literature review/behavioural lens, lab/online experiment, RCT).

Stage 5: Change

The final stage is to take what worked – and what didn't – to inform public policy develop and ensure society benefits from the insights gained. Here, the policy maker is encouraged to revisit the political context or policy challenge that motivated the project, as well as the work done in stages 1 and 2 to define the approach and scope the project. This is to ensure the policy situation and interests of the project still align with the current situation, as changes can occur. Then the best way to implement and scale up the behaviourally-informed policy should be considered, which could be a new law or regulations, or perhaps a new code or guideline would suffice. Structures need to be put in place to monitor the long-term and potential side effects of the policy intervention to ensure the quality of the new policy is maintained over time. Finally, communicating the results the community, even when they are null results, is essential to ensure peer learning.

Notes

[1] Going forward, if there are industries and/or aspects and areas that further study is merited this review can be refined.

[2] BASIC did not exist at the time of writing this scoping note in 2017. Therefore, the ABCD model used in BASIC was not applied here. The work accomplished is more a description of how the behaviours were analysed in regards to the context, which helps support analytical thinking about behavioural problems. This is in-line with the purpose of the Analysis stage, which advocates for many complementary models to be used in lieu of ABCD.

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4 Findings from experiments on fostering a culture of safety in Canada, Ireland, Mexico and Oman

This chapter presents results from a two-phased online experiment on applying behavioural insights to safety culture with regulators and regulated entities from Canada, Ireland, Mexico and Oman. It will discuss the key findings of these results for each country.

The preceding chapters introduced the theory behind applying behavioural insights (BI) to changing the behaviour of organisations, as well as explained the origins and initial scoping exercise conducted to understand how this theory could be applied to fostering elements of safety culture in the energy sector. These findings were complemented with case studies with five regulators to demonstrate how regulators currently address safety culture in their respective countries. Each of these pieces were discussed in the OECD Network of Economic Regulators (NER), which is a body of over 70 front-line regulators from around the world and has been central in developing research on applying BI to regulatory policy since 2013 (Lunn, 2014[1]); (OECD, 2016[2]); (OECD, 2017[3]); (OECD, 2017[4]).

The results of this collaboration with the NER community, academics and behavioural practitioners were a strong understanding of the enablers and barriers in safety in the energy sector, as well as insights into how behavioural science could support better outcomes in this field. Under the auspices of the NER and with the support of the Government of Canada (Natural Resources Canada and Canadian Energy Regulator, CER); Ireland's Commission for Regulation of Utilities (CRU); Mexico's Agency for Safety, Energy and Environment (ASEA); and Oman's Authority for Electricity Regulation (AER), a set of experiments were developed and implemented to test the application of BI to safety in the energy sector. This was accomplished in two phases: first, a survey-based experiment was conducted with the four project partners that tested perceptions of safety and effectiveness of behavioural vignettes and, second, a follow up survey-based experiment with Ireland's CRU that tested how to improve conformity with safety regulations amongst small-scale gas and electricity installers.

These experiments constitute one of the first applications of BI to the study of safety, elements of safety culture, and the improvement of safety outcomes in the energy sector. The findings presented below enhance the practical understanding of the application of BI to organisational behaviour and pushed the frontier towards a more frequent integration of the field of BI and safety. As this project was in itself an innovative and experimental undertaking, results point to the need for further research and greater understanding in many areas, including a better understanding of contextual, sub-national, and group drivers. Furthermore, relatively small sample sizes for Canada and Ireland in phase one lead to caution interpreting results and the call for further research, especially in Canada who did not receive a follow up experiment compared to Ireland in Phase 2.

This chapter presented an overview of the methodology, as well as the results and key findings from these two phases. For phase one, the methodology and initial results were presented in (OECD, 2019[5]), which focused on the high-level horizontal findings for regulatory policy in the energy sector. This chapter will provide a brief summary of (OECD, 2019[5]) and complement these findings with additional country-based analysis and results to understand more clear what worked, and what did not, for each project partner. As phase two was still underway when (OECD, 2019[5]) was published, the second section of this chapter will present the full methods and results from this second experiment.

Context: Countries involved in the BI experiments on safety

As noted above, the overall project was conducted in partnership with energy regulators from Canada, Ireland, Mexico and Oman. As each country and sector possess particular characteristics with regards to how they regulate their sectors, it is worth describing the context and basic features of each regulator included in the analysis. This discussion was originally contained within (OECD, 2019[5]) and is replicated here as it is relevant for the proceeding discussions on methods, results and key findings. These countries were selected based on convenient sampling.

Canada

The Canadian Energy Regulator (CER), formerly the National Energy Board (NEB), is Canada's energy and safety regulator. It makes regulatory decisions and recommendations that represent the interests and concerns of Canadians. In doing so, the CER factors in economic, environmental and social considerations. The CER oversees safety and environmental protection for the full life-cycle of a project – from approval to construction, operation, abandonment and works with communities, sharing the goal of making energy infrastructure as safe as it can be. The CER also monitors aspects of energy supply, demand, production, development and trade which the federal government controls. The CER reports to Parliament through the Minister of Natural Resources.

Ireland

The Commission for Regulation of Utilities (CRU) has responsibility for safety in the energy sector in three broad sectors:

- Regulating the activities of natural gas and liquid petroleum gas (LPG) undertakings with respect to safety under the Energy (Miscellaneous Provisions) Acts (2006[6]) and (2012[7]). This is carried out under the Gas Safety Framework, which covers shipping, supply, storage, transmission, distribution and use of natural gas, as well as certain specified LPG undertakings.
- Regulating upstream petroleum safety, including offshore safety under the Petroleum (Exploration and Extraction) Safety Acts, 2010 and 2015. This is carried out under the Petroleum Safety Framework (PSF) Requirement of the Petroleum Safety Framework (CER, 2017[8]).
- Designation and oversight of the safety supervisory bodies charged with monitoring natural and liquid petroleum gas installers and electrical contractors doing domestic gas and electrical works respectively, with respect to safety under the Energy (Miscellaneous Provisions) Acts (2006[6]) and (2012[7]) .

Mexico

Created in 2015, the Agency for Safety, Energy and Environment (*Agencia de Seguridad, Energía y Ambiente*, ASEA) is a technical regulator responsible for industrial and operational safety and environmental protection in Mexico's hydrocarbons sector (OECD, 2017[3]). It oversees activities throughout the hydrocarbons value chain, from exploration and extraction to midstream and downstream transformation, production and storage as well as distribution and retail at the petrol station level. ASEA's aims are mapped under five dimensions (clients; industry; process; organisation and learning; and financial resources) and within each of these dimensions, there are medium- to long-term visions.

Oman

The Authority for Electricity Regulation (AER) is responsible for regulating the electricity sector and some aspects of the water sector. It was established by Article 19 of the Law for the Regulation and Privatisation of the Electricity and Related Water Sector promulgated by Royal Decree 78/2004 on 1 August 2004 and Amended by Royal Decree 59/2009 and 47/2013 ("the Sector Law"). The authority is a financially and administratively independent organisation and reports directly to the Council of Ministers. The authority's duties under the Sector Law are to protect the interests of its three main stakeholders: electricity customers, electricity sector companies, and the Government.

Phase 1: Cross-national experiment with Canada, Ireland, Mexico and Oman

As discussed in previous chapters, as well as in (OECD, 2019[5]), the departure point for these experiments were two-fold. First, while individual-level errors, such as inattention, forgetfulness and procedural violations, have long been regarded as principle factors behind safety incidents and disasters (Reason, 1990), there is also an understanding safety can often be linked to the organisational conditions within which the individuals work. The perception of these conditions are a fundamental driver in safety. Second, "safety culture," defined as the set of "shared values, beliefs, attitudes, norms and practices related to safety within an organisation" (TRB, 2016[9]); (Cooper, 2000[10]) is an important aspect of larger organisational culture and crucial in preventing organisational accidents. These include high-consequence accidents, such as the nuclear safety systems failure at the Fukushima Daiichi plant in Japan in 2011 (OECD/NEA, 2013[11]) and the organisational and cultural lapses that contributed to the BP Deepwater Horizon oil spill in 2010 (Reader and O'Connor, 2014[12]); (Corkindale, 2010[13]).

Together, these departure points lend strong support to further research on safety culture and actions that regulators could take to use this better understanding to improve outcomes for society, the environment and the sector. While there has been some academic and government-led research on safety and regulatory policy previously conducted (see Chapter 3), this field is relatively under studied and the understanding by regulators and knowledge of how BI could help was seen as relatively low. For these reasons, the survey-based experiment was designed with representatives from both the regulators and regulated entities in the energy sector to test the application of BI to different dimensions of safety culture. The experiment was designed to capture participants' perception of (OECD, 2019[5]):

1. The perceptions of workers from regulators and regulated entities regarding safety culture in their respective areas (safety culture).
2. The extent to which different actors would respond to the potential application of behavioural insights to common safety problems (scenarios/vignettes).

Behavioural insights tested in phase 1

As discussed further in Chapter 3 of this publication and in (OECD, 2019[5]), there are four key BI principles identified in the safety culture literature that were first identified as potentially viable for this experiment:

1. Messenger: The way we process the same information differs depending on who we receive it from (Clark et al., 2013[14]); (Eckel and Gintis, 2010[15]). For example, individuals are more likely to believe a message when it comes from an authority figure or expert, conform to the behavioural aspects of a message resulting in decreased violations overall, and appreciate information more when it comes from people they have positive feeling about or who are a bit like themselves.
2. Social influences: Humans are social creatures and look to others for information on how they themselves should behave (Bicchieri, 2005[16]); (Goldstein et al., 2008[17]). This is relevant to many psychological mechanisms, but two are important here:
    a. Social benchmarking / feedback: People pay attention to feedback in almost everything they do and often cannot adjust their behaviour without it. Providing a benchmark can reduce mistakes and make the consequences of decisions more salient. For example, providing pre- and post-shift hearing test results to workers can increase the use of hearing protection in subsequent shifts, overcoming what is known as the "present bias" (Zohar, 1980[18]). However, we do not always get personal feedback on what we do and often look to the behaviour of others and the feedback they receive.
    b. Social norms: Evidence also suggests that people tend to survey their social and physical environment for attitudinal and behavioural cues and they care deeply about what their neighbours do. This is especially true when their neighbours belong to their same social in-

group. Social norms act as a standard, informing individuals of what others think and do. There are a number of behaviourally-informed initiatives that make use of social norms, which are detailed in (OECD, 2019[5]). Speaking up about unsafe practices in the workplace is particularly interesting for the purposes of this experiment.

3. Reciprocity: The power of "reciprocity" for inducing co-operation is also a well-replicated effect in the behavioural literature (Fehr, Fischbacher and Gächter, 2002[19]); (Rand, Yoeli and Hoffman, 2014[20]). As social beings, people like to keep promises and reciprocate. Therefore, when people observe that others are taking the time to do things for them, they are more likely to continue that engagement. (OECD, 2019[5]) has more details on this effect.

Through discussions with project partners and country contact points, it was decided to focus on messenger, feedback and social norms in the survey-based experiment.

Methodology

(OECD, 2019[5]) provides a detailed overview of the methodology, which is summarised below. The experiments conducted were the result of extensive scoping and engagement with project partners and the NER community. This was supported by discussions regarding the project and themes with representatives from each participating country to gain an understanding of each specific context. Further discussions were had with academics at the London School of Economics (LSE) and explored in a scoping literature review. Chapters 3 and 4, above, provide this scoping review that mapped the ways BI could be applied to safety and present case studies from five NER countries, respectively.

Informal focus groups composed of representatives from regulators and regulated entities were also engaged to gain detailed feedback on safety culture and the behavioural principles to be tested, and used to iterate versions of the questionnaire. Finally, a number of academic experts and practitioners from the wider safety culture and BI communities were engaged for additional feedback on the experimental design and application of BI principles. Ethical approval was obtained from LSE and researchers followed OECD principles of confidentiality and ethics (OECD, 2016[21]). The study was also pre-registered after data collection, but before data analysis, on the Open Sciences Framework (Tear and MacLennan, 2018[22]).

Experimental design

The experiment was conducted via a computer-based questionnaire that was distributed to respondents, who completed it in their own time. Distribution was via email sent to respondents within regulators, as well as contact points within regulated entities who passed the survey onwards to frontline staff, managers and senior management, including contractors. Exclusions and additional details are noted in (OECD, 2019[5]).

For Canada, Ireland, and Oman, the email and experiments were in English. For Mexico, they were both translated into Spanish. However, respondents could respond in either English or Spanish. Contact points in ASEA read through the translated documents and agreed on translation.

The questionnaire was sent in August 2018 and responses were collected for six weeks, with a reminder message in early September. This was particularly important as it was highlighted that some staff work on five-week rotations and likely would not receive the initial email.

The questionnaire was divided into four main sections (further details can be found in (OECD, 2019[5]), including the complete questionnaire in Annex 5.A of that publication):

1. Demographics: This section collected basic, unidentifiable data which could inform the analysis in the following section. Questions were purposely minimal so that individuals could not be identified and their privacy was protected, with the goal of especially promoting honesty in their responses to the following sections.

2. Safety culture/climate questions: This section was included based on discussions in the NER and scoping discussions had with academics and contact points. Emphasis was placed on understanding the extent to which views on safety culture different between individuals in regulated entities and in regulators. Respondents answered questions based on a 7-step Likert scale ranging from Strongly Agree to Strongly Disagree. Questions were administered in the same order for everyone.
3. Behavioural vignettes/scenarios: These asked respondents from regulators and regulated entities questions testing the application of the three BI principles in three scenarios: 1) the introduction of a new guideline regarding Personal Protective Equipment (PPE); 2, Reports of a bad lost-time injury rate; and 3. A situation where a supervisor asks a worker to carry out a task in an unsafe manner. This methodology is common in the BI literature, but not often used in safety culture literature. Thus, this experiment is innovative both in terms of subject (dimensions of strong safety culture) but also methods employed. (OECD, 2019[5]) acknowledges that these examples are not reflective of safety culture as a whole and have drawbacks. More details on these and vignette design can be found in (OECD, 2019[5]). While respondents were not randomised into treatment and control, the presentation of the vignettes were presented in randomised order and similar vignettes were not asked together as a group.
4. Qualitative: Respondents were provided a space at the end of the questionnaire to provide reasons why they selected as they did for each experiment. While people are often poor predictors of why they make certain decisions, this does provide useful additional information to interpret results.

Cross-national results

The following section describes the results of the study. The first part will be a summary of the cross-national results presented in (OECD, 2019[5]), followed by a country-by-country analysis of the quantitative and qualitative data. For both the safety culture question as well as the BI experiments, three main hypotheses were tested:

1. Regulator vs. regulated entity: Are there differences between the regulator and regulated entities in terms of the effectiveness of the scenarios? This is an exploratory hypothesis.
2. Country differences: Are differences between regulator and entities driven by national context? Can national culture account for the differences?
3. Frontline vs. manager differences: In nations where power distance is high (Oman, Mexico to a lesser extent), are there differences in responses between frontline staff and management staff? Is this related to the safety culture of the organisation?

Overall response rate was N = 1 366. Those who responded to less than 50% of section 2 (safety culture items) or section 3 (vignettes) were removed. This left N = 1 033 for the safety culture sample and N = 855 for the behavioural vignettes. These are not independent samples – it is possible, and likely, that participants would appear in both samples.

Response by nationality is 28 from Canada, 92 from Ireland, 409 from Mexico and 504 from Oman. Given the analysis of the possible sample for Canada in (OECD, 2019[5]), it can be concluded that the sample size is very low and potentially susceptible to selection bias. Caution is encouraged inferring conclusions with the Canadian sample.

A full explanation of the cross-national results by each of the behavioural insights tested can be found in (OECD, 2019[5]). They can be summarised as:

- Messenger: Overall, the messenger of safety instructions seems to mostly only matter in Ireland and Oman. In those countries, the peer messenger was perceived to be the least effective messenger vehicle. From a Hofstedian perspective, Ireland and Oman do not share many cultural

similarities. Where they do share similarity is in the rate of regulator worker to entity worker responses (Ireland 1:3; Oman 1:4). Perhaps this majority of entity worker responses explains why the peer messenger was perceived least favourably. Where there is a messenger effect, its direction is such that messages from managers and regulators are deemed more effective than messages from peers.

- Feedback: While feedback was overall the most impactful behavioural principle among the ones tested, A deeper investigation into the responses to the feedback vignettes failed to reveal any differences at the country, occupational or organisational level.
- Social norms: In general, norms were found to be the least effective behavioural principle overall. However, cross-national comparisons revealed some interesting trends. In particular, the Mexican sample was the only nationality for which there were statistically significant results with regards to norm type. Mexican respondents were found to react more strongly to descriptive norms than control or injunctive messages. From a Hofstedian perspective, Mexican samples score high on uncertainty avoidance, meaning that the clear signal from descriptive norms may be preferred over the motivationally unclear nature of injunctive norms. Mexican samples also score low on individualism, meaning that they may be more susceptible to group norms in general.

However, there are multiple limitations discussed in (OECD, 2019[5]). These include the varying degrees of English abilities, particularly in Oman, and that we relied on contact points within the regulated entities to pass along the information. Attempts were made to counteract these limitations, where possible. There is also no objective benchmark to compare workers' safety cultural perceptions. We also cannot test regulator's perceptions of the state of safety culture in the sector, nor does the data support such a conclusion. There is also likely a degree of overlap between the three BI principles tested.

Policy lessons from the cross-national results

These lessons were presented in (OECD, 2019[5]), but bear repeating again since they are relevant to the discussion going forward in this chapter.

Overall, the project constitutes one of the first applications of behavioural insights through online experiments to the study of safety improvement and elements of safety culture. It is intended to serve as a stepping stone towards a more frequent integration of the field of BI and safety. A number of key policy lessons emerge from the research.

- **To avoid unintended negative consequences, it is important for regulators to take into consideration differences in perception within and between actors when designing new safety regulations or policies**. The study found that the closer one is to the front line, the lower one's perception of safety culture. From a system perspective, the study showed that regulators have a more negative perception of safety culture in the regulated entities than the entities themselves, perhaps due to their position overseeing the sector. Moreover, results show that senior managers reacted most favourably to the behavioural principles (i.e. feedback, messenger effects and social norming) than other occupations, indicating that there are differences of perceptions within entities (not only between entities and the regulator) regarding safety culture. When developing policy, it is important to take these differences in perception into consideration to ensure policies are targeted for different audiences.
- **The study found that some feedback is better than no feedback but the results are inconclusive as to which type of feedback or benchmarking is best**. Results show that respondents reacted most favourably to feedback vignettes, compared to messenger and norm vignettes, generally speaking. From a policy perspective, this highlights the importance of considering providing workers with some form of feedback. However, which form of feedback is most effective and whether feedback is beneficial in every context needs to be studied in further detail.

- **The source of safety messages (messenger) still matters, which highlights the need to ensure regulators and senior managers in regulated entities are working together to encourage a culture of safety**. Results showed that respondents reacted similarly to messages on safety coming from a regulator as well as senior management of the regulated entity. However, messages from peers were considered the least effective, which runs counter to conventional thinking about the use of norms in nudging.
- **Social norming was perceived as the least effective across the sample, which requires more research to determine the benefit for policymakers of using social norms to encourage a culture of safety**. Results for all social norm vignettes were statistically indistinguishable from the control. However, some differences were noted for respondents rating the descriptive norm vignette more positively than the control vignette, giving some possible avenues for future research.
- **Differences between countries highlight the need for policymakers to take a location-based approach to strengthening elements of safety in their own contexts**. While the above notes the trends for each behavioural insight tested, between-country differences were notable. For feedback, there were no statistically significant differences at the country level; however, results did show respondents from Oman reacted most favourably, followed by Irish respondents, and then Canadian and Mexican respondents alternating for least favourable responses. Caution should, however, be taken inferring results from the Canadian results due to small sample size. For the messenger effect, it seems that this really mattered most in Ireland and Oman, perhaps due to a similar regulator worker to entity worker response rate. For social norming, the Mexican sample was somewhat responsive to descriptive norms, though Irish and Omani responses were also favourable. Canadian responses were least favourable.

Phase 1: Country-level results

(OECD, 2019[5]) presented preliminary, cross-national results that were summarised above and presented in full in the aforementioned publication. This initial data analysis revealed a number of avenues for further exploration where the data were sufficient. Particularly, the analyses in (OECD, 2019[5]) explored differences between nations – there is a good opportunity to look at where differences exist within nations, that is, what works best within a nation rather than what works best across nations. We report on some of these additional analyses below.

The role of safety culture

Safety culture in these data refers to the perceptions that individuals have regarding the norms and behaviours related to safety in regulated entities. Safety culture is usually considered the outcome of many individual and group behaviours, perceptions, and norms interacting. Indeed, complex social systems can be constructed as micro- and macro-level social properties (Conte et al., 2007[23]). Under this conceptualisation, behaviours and norms would be considered micro-level social properties, which give rise to the macro-level social property of culture. An important notion here is that micro-social entities generate effects at the macro-social level that they do not perceive nor, therefore, aim at. Part of the generative process is external to their minds.

Yet, culture itself can generate effects at the lower level too, via comparatively simple or complex loops. In the context of safety culture, an organisation's emergent safety culture is determined by the interaction of individuals' behaviours, perceptions, and norms, but also determines the behaviours, perceptions and norms of individuals. This relationship between safety culture and perceptions of safety culture could be described as a feedback loop, where perceptions of safety culture also shape the culture itself.

Thus, it is important to consider the safety culture ecosystem that our surveys took place in. Practically, this means examining how individuals' perceptions give rise to an organisational safety culture, but also how the safety culture of an organisation shapes individuals' perceptions. To do this, we segment analyses by whether the participant views entity safety culture as average, below-average, or above-average.

What does a safety culture score mean?

Participants in our survey filled out a number of items targeting various different factors of safety culture: 1) management commitment to safety; 2) regulator commitment to safety; 3) colleague commitment to safety; 4) collaboration for safety; 5) reporting incidents; 6) communication for safety; 7) safety support; 8) relationship between the entity and the regulator. Participant perspectives on these factors are summarised into a single safety culture score, which is taken to reflect how positively or negatively they view the overall safety culture of regulated entities:

> *Safety culture scores represent how much safety culture the individual perceives in regulated entities (a measure of an organisation's safety culture).*

Safety culture scores might also reflect an individual bias within the participants themselves. That is, individuals might be predisposed to see safety culture more positively or negatively than it actually exists. This bias would be similar to an optimism or pessimism bias.

> *Safety culture scores represent just how likely each individual is to perceive safety culture (their baseline safety culture perception).*

Our data are not able to determine which of these correct and it is likely that there are elements of both in an individual's safety culture score.

Behavioural insights approaches to improving safety culture

Overall, the more positive your safety culture score, the more optimistic you are about the vignettes. That is, if you say your organisation/the regulated entity has a strong and positive approach to safety, then you are more likely to think that the BI principles would be effective for improving safety behaviour. Conversely, the people who thought the BI principles would be relatively less effective were also those who said that their organisation had relatively weaker and/or negative approach to safety, on average.

Based on the previously discussed two constructs that safety culture scores might reflect, there are at least two possible interpretations for this result. The first is that behavioural insights approaches to safety culture might be best suited to organisations with pre-existing positive safety cultures.

The second interpretation is that individuals with a safety culture optimism bias are more likely to endorse novel approaches to improving safety culture. Indeed, there is work highlighting that organisational safety attitudes (e.g. injunctive safety norms, the balance between safety and productivity) are significantly related to agreeableness, conscientiousness, prevention regulatory focus, and fatalism (Henning et al., 2009[24]). When considered in the context of the personality literature, there are strong links connecting optimism with agreeableness and conscientiousness (Sharpe, Martin and Roth, 2011[25]). Tying it back to the result – the positive relationship between safety culture and the endorsement of the BI principles might be explained by a third factor: individuals' optimism.

Thus, we must always consider that an individual's safety culture score is influenced by at least two factors simultaneously: 1) the safety culture environment they exist in; and 2) their own propensity for optimism or pessimism. It is likely that these two factors are highly related, for example, it might be that organisations with positive safety cultures are filled with people who might be described as safety culture optimists – that is, strong organisational safety culture creates safety culture optimists.

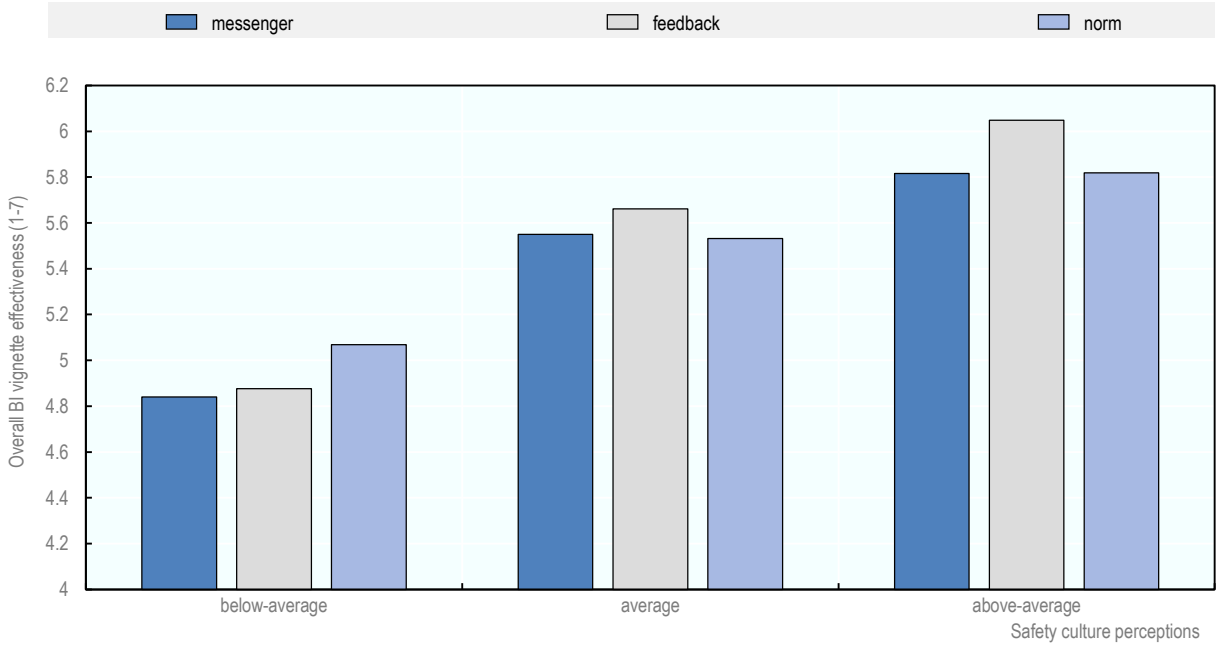
Segmenting according to safety culture

Where we have sufficient data, we can group participants according to their safety culture score – below-average, average, or above-average safety culture. We can then use these groupings as lenses through which to view other data. While we are perhaps most interested in what works best in entities with average safety culture (i.e. the majority of entities in the case of a normal distribution), it is also useful to see what individuals think would be effective at the extremes of safety culture: comparatively weak or strong safety culture.

Below-average and above-average refers to individuals whose safety culture scores were ±1SD from the mean. Due to the nature of normal distributions around the mean, the below- and above-average groups have considerably smaller sample sizes than the average group, which means there's a larger degree of error in the below- and above-average segments. This means that, while a difference may be significant in the average group, a larger difference may not be significant in the below- or above-average groups due to larger degrees of error.

Looking at the whole sample, below-average safety culture perceivers favour the norm vignettes, whereas average and above-average safety culture perceivers favour feedback (see Figure 4.1).

Figure 4.1. Vignette effectiveness as a function of safety culture



Note: Below average: norm significantly greater than messenger (p=.029). Average: feedback significantly greater than both messenger (p=.002) and norms (p<.001). Above average: trends for feedback to be significantly greater than messenger (p=.058) and norms (p=.067).

From this we can infer that participants believe that organisations with below-average safety culture might benefit most from norm interventions, whereas they believe that average or above-average safety culture organisations might benefit most from feedback interventions.

It is difficult to extrapolate the meaning of these results without further data for a number of reasons. First, a low organisational safety culture score could literally be taken to mean the organisation has weak safety culture. Conversely, if workers feel like they can voice criticism without penalty, then this is also indicative of a strong safety culture score. Second, 'below-average' in this context is not equivalent to "poor performance" All safety culture averages are above the scale midpoint and, thus, still reflect positive safety

cultures. Third, these are hypothetical safety culture scores and are not reflective of any particular organisation. That is, these safety scores do not literally reflect the safety culture an organisation, rather they represent the imagined safety culture of a hypothetical regulated entity. Most simply, participants imagined the safety culture of typical entities in their sector, so to extrapolate beyond these data would be ill-advised.

To better understand why participants believed that norm interventions would work best in below-average safety culture organisations and feedback would work best in other organisations, researchers would need to speak further with participants to unpack their reasoning.

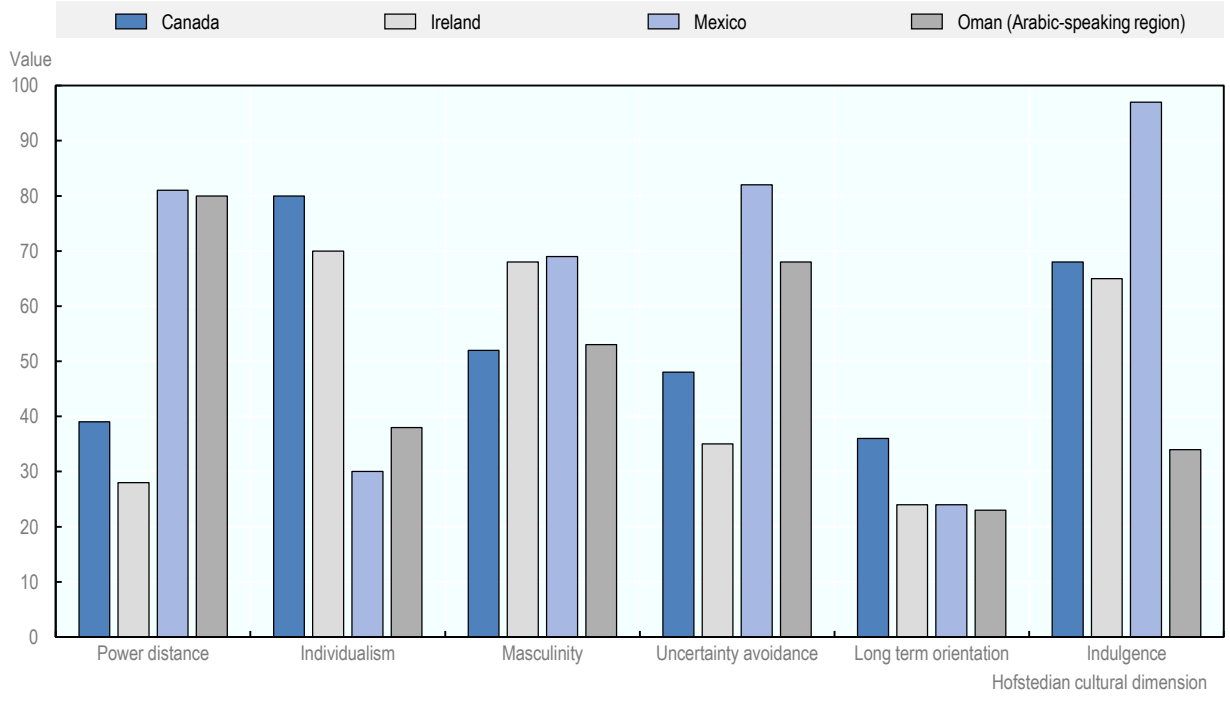
National contexts

Next we can segment according to national context to see how below-average, average, and above-average safety culture perceivers respond to the vignettes in each country. There were insufficient data in the Canadian sample for analyses of this complexity.

Hofstedian national cultural dimensions have often been used for interpreting organisational culture (Hofstede, 2001[26]); (Reader et al., 2015[27]). Figure 4.2 presents the Hofstedian cultural dimension values for the nations participating in this research. These scores are provided for potential context when interpreting the data following.

Note that the Hofstede model does not provide scores for Oman, instead grouping all Arabic-speaking countries together into one regional score. While there were insufficient quantitative data from the Canadian sample, it may be useful to reflect on the data from the Irish sample, given their cultural similarity to Canada.

Figure 4.2. Hofstedian cultural dimension values for participant countries



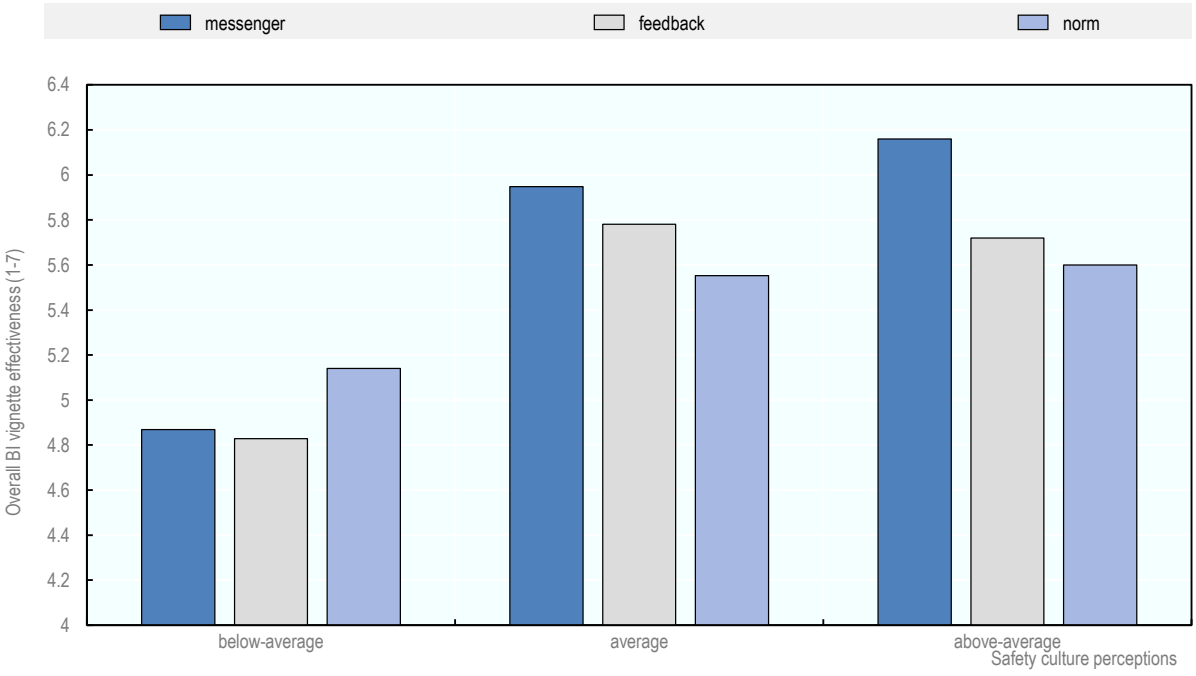
Source: (Hofstede, n.d.[28])

Ireland

These data are presented with the caveat that they are underpowered and should be interpreted with caution. Below-average safety culture perceivers saw the norm vignettes as more effective, whereas average safety culture perceivers saw norms as less effective. Above-average safety culture perceivers thought messenger interventions would be most effective (see Figure 4.3).

Qualitative data described later in this report provide greater detail for the successful implementation of messenger interventions.

Figure 4.3. Vignette effectiveness as a function of safety culture in Ireland

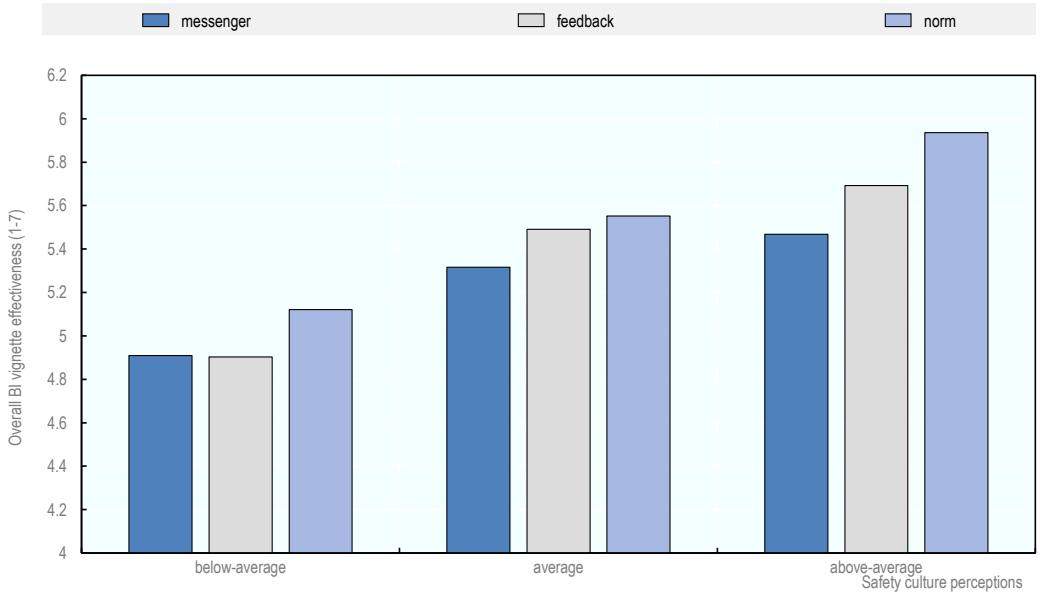


Note: Below average: no significant differences. Average: messenger significantly greater than norms (p=.001). Above average: no significant differences.

Mexico

Average and above-average safety culture perceivers were more likely to see the feedback vignettes as less effective (with a tendency towards endorsing norm vignettes), whereas below-average safety culture perceivers thought all principles would be equally effective (difference between principles not significant; see Figure 4.4).

Figure 4.4. Vignette effectiveness as a function of safety culture in Mexico

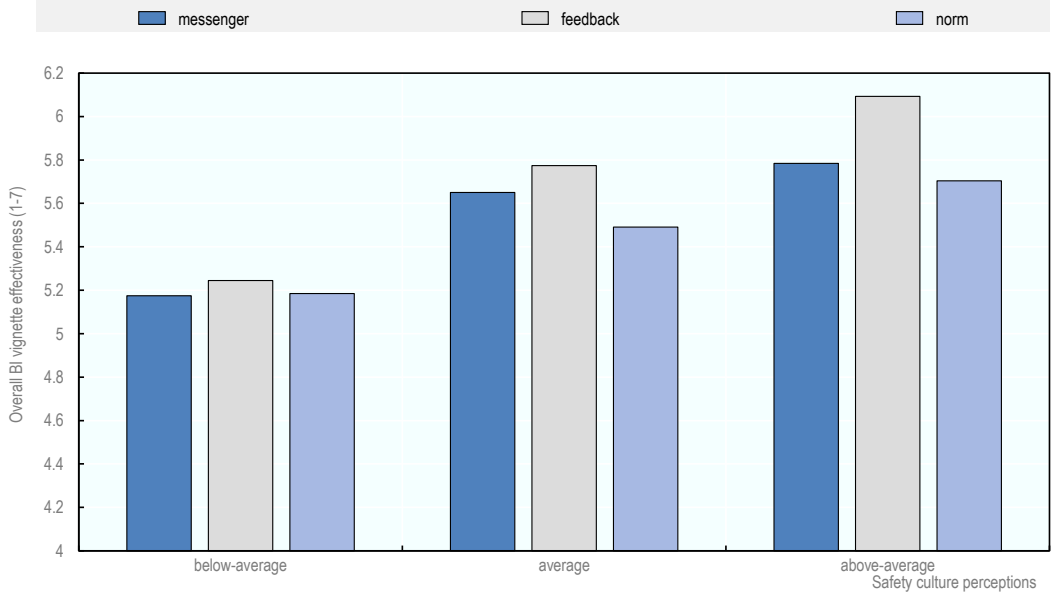


Note: Below average: no significant differences. Average: messenger significantly worse than feedback (p=.001) and norms (p<.001). Above average: no significant differences.

Oman

Below-average safety culture perceivers felt that norms were the most effective vignette, average safety culture perceivers felt that the feedback and norm vignettes would be more effective than norms, and above-average safety culture perceivers felt that feedback initiatives would be most effective. See Figure 4.5 for these data graphically represented.

Figure 4.5. Vignette effectiveness as a function of safety culture in Oman



Note: Below average: no significant differences. Average: feedback significantly greater than messenger (p=.038) and norms (p<.001); messenger significantly greater than norms (p=.008). Above average: feedback significantly greater than norms (p=.016).

Summary of safety culture segmentation

We can draw a number of conclusions from the above national analyses, which are summarised in Table 4.1. A plus indicates the vignette was statistically the best performing, a minus means statistically the worst performing, and a question mark indicates no statistically significant difference.

Norm interventions were predicted to be the least successful in Ireland, except in the cases of relatively weaker safety culture organisations. Rather, a messenger approach was often reported as being the most likely to have success.

For Mexico, norm interventions were consistently the favoured approach, with feedback sometimes showing promise.

The Omani sample favoured feedback, though messenger approached sometimes approached significance.

Table 4.1. Summary of vignette effectiveness across national contexts

		Messenger	Feedback	Norm
Ireland	Below average	?	?	?
	Average	+	?	–
	Above average	?	?	?
Mexico	Below average	?	?	?
	Average	–	+	+
	Above average	?	?	?
Oman	Below average	?	?	?
	Average	–	+	+
	Above average	?	+	–

Note: A plus indicates the vignette was statistically the best performing, a minus means statistically the worst performing, and a question mark indicates no statistically significant difference

Segmenting according to occupational role

The above data provide important implications for the roll-out of behavioural insights approaches to safety culture by demonstrating that the success of different approaches might depend on the level of safety culture in the entity. Below we continue these analyses by checking whether this relationship between entity safety culture and predicted impact of the behavioural insights approaches differs according to participants' occupational role.

According to the literature, perceptions of safety culture are known to vary according to occupational role (Parand et al., 2010[29]); (Tear et al., 2020[30]), perhaps largely due to differences in organisational perspective associated with different roles (e.g. frontline staff have the most specific but least wide view of the organisation, senior managers have most wide but least specific view of the organisation). By taking this lens to the data we can determine if individuals in different occupational roles will be more affected by the safety culture of the entity when they report how effective the BI approaches might be.

It is useful at this point to remind the reader exactly what we have measured. The survey was distributed to workers in regulators and regulated entities. Those workers were asked to imagine a typical regulated entity in their sector and evaluate how effective various different BI approaches would be for improving safety culture and/or safety behaviours in that imagined entity. We also asked them to respond to questions about that imagined entity's safety culture.

In the previous section, we demonstrated that when workers imagined the safety culture of a typical entity in their sector was more positive than average, then that worker was also more likely to think that the BI approaches would be successful. Conversely, when they imagined the safety culture of a typical entity to be less positive than average, then that worker was also less likely to think that the BI approaches would be successful.

Now we are checking to see how workers' occupation relates to how they think about the typical entity and its safety culture. Does being a frontline worker change the way they see the safety culture and, thus, change how effective they think the BI approaches would be? If a senior manager and a worker from the frontline imagine typical entities with the same safety culture, do they think the BI approach will be similarly effective?

Because there are known links between national culture and organisational safety culture (e.g. national power distance accounts for the difference in perspective between frontline staff and management), we breakdown the following results according to national context.

Ireland

Looking at the overall Ireland data for how safety culture affects ratings of the vignettes, we can see that managers appear not to be affected. On the other hand, senior managers and other staff appear much more affected. Frontline staff are also affected but not as much as senior managers and other staff. A full breakdown of the vignette effectiveness data according to each specific item are provided in Table 4.2 below, and more in depth results are provided in Appendix 4.A. The Ireland data are highly volatile due to the small sample size.

Table 4.2. Breakdown of how safety culture affects perceived effectiveness of vignettes according to occupational role in Ireland

	Safety culture impacts perceived effectiveness of vignettes most for...	Safety culture impacts perceived effectiveness of vignettes least for...	Notes
(1) This safety information would attract <the attention of workers/my attention>			Safety culture affects all occupational roles equivalently
(2) This safety information should affect how <workers in entities do their job/I do my job>	Senior managers and other staff	Frontline staff and managers	Trend for negative effect of safety culture for frontline staff and managers
(3) This safety information would affect how <workers in entities do their job/I do my job>	Senior managers and other staff	Frontline staff and managers	Managers are unaffected by safety culture (non-significant)
(4) This safety information should affect how <the entity overall/how managers do their job>	Senior managers and other staff	Frontline staff and managers	Senior managers are the only group significantly affected by safety culture
(5) This safety information would affect how <the entity overall/how managers do their job>	Managers, senior managers, and other staff	Frontline staff	No significant difference between managers, senior managers, and other staff

Mexico

The effect of safety culture on the effectiveness of the vignettes is varied in the Mexican context according to occupational role. Senior managers are the most affected by safety culture (item 1) but not in other cases (items 2 and 4). Similarly frontline staffs' ratings of the behavioural insights principles are most

affected on some items (items 1 and 4) but least on others (items 2, 3, and 5). While these differences exist, it is important to note that they are small and that safety culture appears to have a roughly equivalent effect for all occupational groups. Full breakdown provided in Table 4.3 and specific graphs are presented in Annex 4.A.

Table 4.3. Breakdown of how safety culture affects perceived effectiveness of vignettes according to occupational role in Mexico

	Safety culture impacts perceived effectiveness of vignettes most for...	Safety culture impacts perceived effectiveness of vignettes least for...	Notes
(1) This safety information would attract <the attention of workers/my attention>	Frontline staff, senior managers, and other staff	Managers	No significant difference between frontline staff and senior managers
(2) This safety information should affect how <workers in entities do their job/I do my job>	Managers and other staff	Frontline staff and senior managers	Senior managers are *unaffected* by safety culture (non-significant)
(3) This safety information would affect how <workers in entities do their job/I do my job>	Other staff	Frontline staff, managers, and senior managers	No significant difference between frontline staff, managers, and senior managers
(4) This safety information should affect how <the entity overall/how managers do their job>	Frontline staff, managers	Senior managers, other staff	Senior managers are *unaffected* by safety culture (non-significant)
(5) This safety information would affect how <the entity overall/how managers do their job>	Other staff	Frontline staff, managers, and senior managers	No significant difference between frontline staff, managers, and senior managers

Oman

When we look at the effect of safety culture on the overall effectiveness of the vignettes in Oman, we can see that there are some differences between the between the occupations. Interestingly, safety culture appears to affect frontline staff and managers roughly similarly, though managers are sometimes more positive about the vignettes than frontline staff. Senior managers often have the most positive view of the vignettes and that view has less to do with the safety culture of the entity. A full breakdown of the results are provided in Table 4.4 and specific graphs are presented in Annex 4.A.

Table 4.4. Breakdown of how safety culture affects perceived effectiveness of vignettes according to occupational role in Oman

	Safety culture impacts perceived effectiveness of vignettes most for...	Safety culture impacts perceived effectiveness of vignettes least for...	Notes
(1) This safety information would attract <the attention of workers/my attention>	Frontline staff, managers	Senior managers, other staff	No significant difference between frontline staff and managers
(2) This safety information should affect how <workers in entities do their job/I do my job>	Frontline staff	Managers, senior managers, other staff	Senior managers are *unaffected* by safety culture (non-significant)
(3) This safety information would affect how <workers			Safety culture affects all occupational roles equivalently

	Safety culture impacts perceived effectiveness of vignettes most for...	Safety culture impacts perceived effectiveness of vignettes least for...	Notes
in entities do their job/I do my job>			
(4) This safety information should affect how <the entity overall/how managers do their job>	Frontline staff, senior managers	Managers, other staff	Other staff are *unaffected* by safety culture (non-significant)
(5) This safety information would affect how <the entity overall/how managers do their job>	Senior managers	Frontline staff, managers, other staff	No significant difference between frontline staff, managers, and other staff.

Qualitative analysis

While there was insufficient quantitative data from the Canadian sample and less than ideal data for the Ireland sample, we were able to extract a number of themes from the qualitative items in the survey. These are described below. We have not analysed the qualitative data from the Mexican and Omani samples because of possible translation errors.

Reminder of Hofstede cultural dimensions

This section serves as a primer for interpreting the following qualitative sections. Canadian and Irish samples are quite similar on each of the dimensions. They believe that inequalities between individuals should be minimised (low power distance) and that individuals should look after themselves and be self-starters at work (high individualism). New ideas, creativity, and a willingness to try new things (low uncertainty avoidance) are characteristic of both nations. Both nations are also considered normative and a focus on quick results (low long term orientation). Finally, they are both considered indulgent (high indulgence) nations, with a willingness to enjoy life and be optimistic.

Where there is difference between the nations is on the masculinity scale, with Ireland being considered a more masculine society than Canada, meaning a greater focus on success and competition.

As with the initial introduction of the Hofstede cultural dimensions earlier, it is important to note that more proximal influences such as perceived management commitment to safety and efficacy of safety measures exert more impact on workforce behaviour and subsequent accident rates than fundamental national values (Mearns and Yule, 2009[31]).

Canada

The qualitative data from the Canadian sample was useful for extracting some specific information regarding the perceived effectiveness of different BI principles for improving safety culture. Regarding messenger effects, Canadian participants mentioned that the most effective message is one that is communicated consistently across all types of messengers (e.g. regulators, managers, colleagues). When the message is consistent across different messengers, then participants suggested that regulators would have the greatest impact — colleague messengers would be impactful to the extent they reinforce messaging from management or regulators. This result should be interpreted with caution, remembering that the Canadian sample was overrepresented by regulator workers by a factor of 6 to 1. Canadian respondents also felt that the size of an organisation would impact the effectiveness of different messengers. Extrapolating this idea, one could imagine that colleague messengers might have a greater impact in smaller organisations, for example.

The Canadian participants also felt that feedback had value, with opinions varied on how much value. There was some question about exactly how useful benchmarking data would be. Some felt that benchmarking was only important for management staff, who sometimes have bonuses tied to benchmarking outcomes, and would have little bearing on frontline staff who are less likely to have such bonuses. There were some who felt benchmarking might have an impact on frontline staff but only to the extent that benchmarking data was provided to them clearly and consistently — if they don't have access to the data, then it can't be useful. Participants generally believed that public information about performance relative to others would be effective. Feedback from the regulator might be useful but benchmarked data would be more useful.

Regarding norms, Canadian participants felt that safety culture is more strongly enhanced by visible action than by proclaimed values. That is, when asked about whether descriptive norms (norms about what people actually do) or injunctive norms (norms about what people ought to do) would have a greater effect on changing safety culture, some respondents said that descriptive norms would have the greater effect. Thus, people visibly implementing safety culture best practice will have a larger impact than organisational values for safety culture.

Ireland

Irish participants believed that regulator or manager messengers would have a stronger impact on safety culture than peer messengers for a number of suggested reasons, which is consistent with the quantitative findings. First, messages delivered by colleagues are susceptible to incorrect, difficult, and possibly reluctant delivery. For example, extolling the benefits of PPE to peers may lead to the peer messenger being ridiculed. Second, safety messages from peers would likely be elevated to senior management if they were important enough. So, a peer messenger might be effective but only via senior management. Management and regulators also tend to have more oversight and context on safety (but important detail can be lost from this perspective). On the other hand, some participants suggested that peer messengers may be impactful in other contexts because peers have shared/similar experiences. Some participants felt that documented or signed off directions will be carried out in the vast majority of situations, irrespective of whether the direction comes from a regulator, manager, or colleague.

The Irish participants noted that while benchmarking was often desired, its implementation was a tricky prospect in Ireland, where there are so few entities to benchmark against. Participants provided a number of factors to consider with benchmarking. First, benchmarking could be considered across industries. While the variation between contexts might be considerable, some participants believed that variation provided vital learning opportunities. Second, benchmarking should clearly distinguish occupational health and safety from process safety. Third, benchmarking is only effective when endorsed by entity management. Fourth, there should be consideration of how often to provide benchmarked data and guides on how to interpret the data. Finally, benchmarking data alone could be counter-productive — those data tell you that a difference exists between entities, but not why. Follow-up activities would be vital in understanding why differences exist in order to develop change strategies.

Irish participants believe that norms are important but described how conflict between injunctive (what ought to be done) and descriptive (what is done) norms can be especially damaging (e.g. we ought to do this but no-one does). It's easy to express a value but at the end of the day, if people aren't doing something, then that's the most important factor.

Suggested policy responses and focus areas

Canada

The qualitative data revealed some further depth to the results presented in the OECD chapter. First, some respondents suggested we should focus less on choosing an effective messenger and more on making sure there is consistent messaging across all messengers. Second, benchmarking would need to be made relevant for all staff, not just management (who may have bonuses tied to benchmarking data). Finally, descriptive normative approaches were thought to have the most impact because they represent what people actually do.

Ireland

These additional analyses unpacked important nuance for the Ireland context. While messengers were established as the most likely to succeed in Ireland, the messenger data from the OECD chapter suggested that peer messengers would be the least effective messenger type. This was corroborated in the qualitative data, where some respondents indicated that it was tricky for individuals to espouse the value of safety to colleagues, potentially making them a target for ridicule. This also relates to the norm vignettes, which were often seen as the least likely to succeed, because Irish respondents would presumably look to management and regulators and be less focused on what their peers are doing. Thus, Ireland should focus on messengers, particularly regulator and management messengers (though important to consider norm approaches in below-average safety culture entities). Senior managers' views on the BI approaches appear highly affected by the safety culture of the entity, which is highly important for pitching BI approaches.

Mexico

The additional analyses revealed that normative approaches were seen as the most effective BI principle, across all safety cultures. Perhaps owning the high uncertainty avoidance often associated with Mexican samples, there was a preference for descriptive norms over injunctive norms, with the notion that seeing what people are actually doing (less uncertainty) would have more impact than hearing about what they value (more uncertainty). Normative approaches might be paired with clear messages from the regulator for maximum uncertainty reduction. Senior managers' views on the vignettes were relatively unaffected by an entity's safety culture, so this should not be leaned upon when pitching to senior management.

Oman

From these additional analyses we can see that a primary focus for Oman should be on investigating the use of feedback with regulated entities. Communication is seen as an important guiding principle, especially from the regulator. It is also important to ensure there is consistency in the messaging, especially from regulators and entity management.

If targeting frontline staff, then it is important to consider the safety culture of the entity, as higher perceived safety culture is associated with stronger beliefs in the vignettes' success. Management views on effectiveness of vignettes seem less affected by safety culture. This suggests that understanding the entity's safety culture will be less useful in pitching BI approaches to management.

Reflections from the literature

Using norms to counteract negative effects from feedback

There were several instances where a norm approach was deemed to be most effective so it is important to consider lessons learnt from previous BI interventions regarding rollout of norm approaches.

A feedback approach was used by the Behavioural Insights Team (2011[32]) for tackling reduced energy consumption behaviours. Providing consumers with feedback on how their energy use compared with similar households in their neighbourhood was shown to reduce energy consumption in higher-than-average users (non-compliers).

There was an unintended negative effect of this feedback, however, for lower-than-average users (compliers). When they received their energy bill, the feedback indicated that they were using less than their neighbours, which conveyed a descriptive norm of greater energy use. This is known as a "boomerang" effect.

To address this unintended side-effect, the descriptive norm was then paired with an injunctive norm (in this case, a smiley face for lower-than-average users). The pairing of the descriptive and injunctive norms with feedback was effective at reducing energy consumption behaviours.

Another approach would be to make sure that feedback only targeted the higher-than-average users, who are not at risk of boomerang effects. This approach has been successfully used in the health context with success. General practitioners who over-prescribe antibiotics contribute to the spread of antimicrobial resistance worldwide. Interventions to reduce the amount of prescriptions within this specific cohort have taken a feedback approach with success. Letters sent to over-prescribing GPs, telling them that other practices were recommending the use of antibiotics in fewer cases, reduced the number of antibiotic prescriptions by 126 352 over a six month period – a reduction of between 9.3-14.6% (BETA, 2018[33]).

Norms approaches were thought to have most impact in two main contexts: 1) Irish entities with below-average imagined safety culture; and 2) Mexican entities with average imagined safety culture. Based on the lessons learnt from previous norm-based approaches, these two contexts are not a risk for boomerang effects, whereas entities with above-average safety culture could suffer boomerang effects. Remember also that descriptive norms are perceived to have a stronger effect than injunctive norms, so there may be difficulty in finding an injunctive norm potent enough to counteract the boomerang.

Presenting benchmarked data

Benchmarking is wanted by most who participated in our study but there are serious questions about how best to present benchmarked data, particularly regarding safety culture. For example, there are aspects of national/organisational culture (e.g. high power distance, high uncertainty avoidance) that are linked to weak safety culture. Thus, some nations/organisations will always rank poorly in comparative benchmarking exercises simply because of their national culture. This limits the opportunities for identifying and sharing best practice.

Some researchers have developed methods for statistically adjusting for the effects of national/organisational culture to allow for a more nuanced safety culture benchmarking approach (Noort et al., 2016[34]). The safety culture against international group norms (SIGN) approach transforms safety culture scores into z-scores and presents the relative position of an organisation with a cultural cluster. SIGN scores highlight variations against a group norm on a normal distribution, and signal a relative position of safety culture strength rather than a direct comparison of raw scores. This means safety culture data are re-scaled to fit a given cultural context, with the assessment of safety culture being directed towards learning between organisations and regions.

For regulator purposes, it would be important to determine a set of parameters for segmenting regulated entities into groups of similar organisations for benchmarking purposes. For example, it might not make sense to compare large with small entities as smaller entities often struggle to devote resources for developing mature safety culture protocol.

Organisational position

A much greater understanding of the lived experience of various different workers should be sought before rolling out a BI intervention. Past research has shown that the work design of a particular occupational role may protect the worker from the effects of national/organisational culture. For example, in a recent published study (Tear et al., 2020[30]), researchers found that air traffic controllers experienced more negative safety culture the stronger their country's national norms for power distance. Yet there was no comparable effect for engineers, whose safety culture perceptions were equivalent irrespective of the national power distance norms.

Qualitative follow-up revealed that, while controllers work quite closely with supervisors who have intimate knowledge of the airspace, engineers are usually subject matter experts and work more autonomously than controllers. If engineers are autonomous from their supervisors, then there is less opportunity for national power distance norms to shape engineers' experience.

This finding suggests that it is important to understand the work design on regulated entity workers before designing a BI intervention. If frontline staff work autonomously, then they may be less receptive to messenger interventions. If they work independently, then they might not pay attention to norm interventions.

We have only consulted a small subsection of regulator and regulated entity workers when trying to determine the effectiveness of behavioural insights approaches to safety culture. This provided a wide range of views on some very simple questions (e.g. "what would work?") but now what is needed is a deep dive into the specifics of entities in various sectors to understand their specific safety culture context. Workshops with subject-matter experts will help to understand whether there are particular idiosyncrasies that would prevent particular behavioural approaches from working (e.g. norm-based approaches might not work for engineers if they are already quite autonomous).

Phase 2: Experiments with registered electrical contractors and gas installers in Ireland

Phase I studied how regulatory policy makers can foster elements of strong safety culture in Canada, Ireland, Mexico, and Oman. The respondents included the staff of the regulators and gas and energy regulated entities—primarily large firms. This second phase study moves from the global perspective to the national perspective thus enabling a more nuanced look into subgroups. This phase also continues to explore the messenger effects of the first study in addition to behavioural insights deemed relevant to the unique context of small scale regulated entities in Ireland under the auspices of the Commission for the Regulation of Utilities (CRU).

The CRU oversees the Safety Supervisory Bodies (SSBs), which administer the safety schemes for Registered Electrical Contractors (RECs) and Registered Gas Installers (RGIs). These are, respectively, the Safe Electric Register of Electric Contractors (hereafter Safe Electric) and the Register of Gas Installers of Ireland (RGII). To be registered, RECs and RGIs must hold relevant qualifications, have completed the necessary training, fulfil other requirements, and remain in good standing with the relevant SSB to carry out electrical and gas works. Each year every REC and RGI is inspected at least once, and any identified non-conformances must be resolved within certain pre-defined periods of time according to the level of severity of the non-conformance.

In 2017, there were over 4 100 RECs and over 2 900 RGIs registered with Safe Electric and RGII respectively. During that same year, more than 4 700 inspections of RECs and more than 3 200 inspections of RGIs were completed. Those inspections identified over 10 000 non-conformances among RECs and 120 non-conformances among RGIs. In 2017, all immediate hazards ("code red") were resolved; however, not all high risk ("code amber") or low risk ("code yellow") non-conformances were resolved within the specified periods of time.[1]

Case studies conducted previously among regulators in Ireland and other countries (see Chapter 3), highlighted the dilution or lack of consistency of safety messages and the lack of committed safety leadership together with inconsistent or contradictory messages as possible barriers to the emergence of a safety culture.

Small scale regulated entities in Ireland

RECs and RGIs work either as individuals or in small firms. Within the safety scheme, RECs may represent more than one electrician who work under an individual REC who is responsible for registering certifying electrical works; however, each individual RGI must be registered.[2] Despite the fact that many RECs and RGIs work individually, they may share a sense of community through shared practices and their shared registration with the SSBs. The industry provides a unique vantage point from which to investigate the intersection of behavioural insights and safety culture. First, there is an indirect relationship between the regulator—the CRU, which is an independent statutory body—and the entities that is mediated by the SSBs with whom the RECs and RGIs register. Second, the regulated entities, RECs and RGIs, are often individuals or small-scale organisations, yet there is reason to suspect that they have elements of a shared culture due to their shared identity (as RECs and RGIs), mode of work, requirements, and sanctions.

These unique aspects broaden the findings from the Phase 1 study with larger regulated entities in the following ways:

- It investigates how the awareness and salience of safety within the scheme differs at three distinct levels: the regulator, the SSB, and the entities. On the one hand, it may be that safety culture is perceived as more positive among SSBs compared to RECs/RGIs, similar to the differences between the 'management' and 'front line' staff in the first phase study. On the other hand, the perception may be worse among SSBs compared to regulated entities in line with the differences between regulators and regulated entities uncovered in the first phase research. This will help reveal differences in awareness at the varied levels of this unique regulatory structure.
- It extends the first study's investigation of the effect of receiving safety information from different messengers. While the first study found the lowest perceived efficacy of word-of-mouth messages from a peer (within the same organisation), a written message from a respected peer REC or RGI who previously conducted training may be perceived differently because they are usually not at the same organisation but still share a group identity which may be a powerful driver of behaviour (Terry, Hogg and White, 1999[35]); (Terry and Hogg, 2000[36]); (Goldstein, Cialdini and Griskevicius, 2008[37]). Likewise, this phase two study will be able to distinguish between different levels of the regulatory structure to determine if the intermediary SSBs are more effective messengers than the regulator due to their heightened social proximity combined with their regulatory authority.
- The larger number of REC and RGI entities enable us to more precisely investigate the degree to which there is a safety culture that goes beyond the level of a single organisation to the level of the industry, and the degree of heterogeneity across a large number of entities within the industry

In addition to these more direct extensions of the first study, this second study addresses new questions that are relevant to the context of Registered Electrical Contractors and Registered Gas Installers in Ireland and can offer insights into similar regulatory schemes where some inspection and supervision responsibilities have been delegated to an industry body.

Methodology

The goal of this study is to examine two aspects of behavioural insights applied to small scale regulated entities in Ireland. First, this study will provides a descriptive overview of the safety culture and behaviours in the two schemes. As a relatively new regulatory regime, there is limited information on the perceptions of the safety schemes among the CRU staff, the SSB staff, and the RECs and RGIs; as such, this study documents the safety attitudes and safety behaviour of the respondents to better understand the two industries.

Second, the study also uses a survey experiment to test the potential for behavioural insights to improve the effectiveness of inspections (see Table 4.5). More specifically, the experiment investigates the salience of safety as a concept that is associated with the SSBs and the CRU, changing the default ordering of inspection forms, prompting implementation intentions, and enhancing salience through the personalisation of communication. These behavioural insights map onto the top nine behavioural insights identified as having more of an evidence base in the process and safety literature by Lindhout and colleagues (Lindhout and Reniers, 2017[38]). The results from the survey experiment are the primary focus of this section.

Table 4.5. Descriptions of behavioural insights used in study

Insight	Description
Implementation Intention	Implementation intentions are detailed planning prompts that specify in detail when and under what circumstances an action should be taken. Through the creation of a specific plan they enhance commitment to action and the associated details serve as reminders to take action.
Messenger Effects	The type of messenger that is used for a call to action can affect the likelihood that individuals engage in the desired behaviour. Important dimensions to consider include how similar the messenger is to the person receiving the message, how trustworthy their expertise is on the topic of the message, and how unbiased the messenger is perceived to be.
Primacy	Primacy is the tendency to focus more attention on content at the beginning of a list. The items that come first are often given more attention than those that come later. In addition, the first and the last items tend to be most memorable.
Personalisation	Personalisation of messaging can increase the likelihood that someone will pay attention to the message, it can also increase a sense of reciprocity as the messenger put forth the effort to personalise the message, and finally it can make the content and the actions more salient and more helpful for remembering the precise action required.
Salience	Salience is how much a given piece of information, and a given call to action, are noticeable and how well they draw individuals' attention. Particular components of a call to action can be made more or less salience through visual changes to written communication (size, colour, and so on), through repetition, through personalisation, and through many other strategies that draw attention to particular parts of a message and the underlying call to action.

This survey-based experiment helps clarify ways that behavioural insights can increase awareness, provide a more nuanced understanding of how to present shared responsibilities throughout levels of the safety scheme, to reduce complacency, and ultimately to contribute to a more pro-active safety culture in these and similar sectors.

Thus, the research questions addressed in this study were:

RQ1. How salient is the association of safety with actors and activities associated with the schemes? How do they differ among respondents?

RQ2. Would a more behaviourally informed INSPECTION REPORT increase the predicted accurate identification and timely resolution of non-conformances?

RQ3. Would a more behaviourally informed NON-CONFORMANCE NOTICE sent after an inspection regarding any identified non-conformances result in a better predicted response rate?

RQ4. How does the originating organisation who sends a message about safety shift the predicted response of the community of regulated entities (RECs/RGIs)?

RQ5. What is the level of safety behaviour and motivation among the respondents? How do they differ by type of respondent?

RQ6. What are the demographic characteristics of the respondents?

A different variant of the survey experiment was provided to the three key respondent groups of (a) the regulated entities (RECs and RGIs); (b) the staff of SSB; and (c) the staff of the CRU. Within each group, respondents were randomised to different arms of the study (see Table 4.6).

Table 4.6. Survey groups and experimental arms

Group	Additional stratification	Experimental arms
RECs and RGIs	(i) scheme (electrical [REC] or gas [RGI]); (ii) registered for more than 12 months (or not);3 and (iii) working as a single-person operation or within a firm.	Arm 1 Arm 2 Arm 3
SSB Staff	None	Arm 1 Arm 2
CRU Staff	None	Arm 1 Arm 2

Note: Respondents in each strata will be randomly assigned to the various experimental arms. Staff from the SSBs and the CRU will not be stratified and will only be randomised to the first two experimental arms due to the limited sample size.

Annex Table 4.B.1 in Annex 4.B provides an overview of the rationale for the six main research questions that the study addressed and how the framing changes based on the experimental arm.[4]

Outcome variables

For RQ1, the salience of the association between safety and a given entity was calculated as follows. Each respondent was asked to associate three words with the entity that they were randomly allocated to. These three words were then analysed using NVivo's Text Search Query to determine how frequently the word "safety" and its synonyms appeared ("content analysis") and the results were also coded by hand as a quality control mechanism. This frequency was then used as the outcome variable in the relevant analytical formula.

For RQ2 and RQ3, two outcomes were calculated and analysed separately. The first was the reported percentage[5] of peers whom the respondent expected would resolve red, amber, and yellow non-conformances (averaged together for each respondent). The second was the reported per cent of the time that the respondent themselves expected that they would resolve the red, amber, and yellow non-conformances (averaged together for each respondent).

For RQ4, the four outcomes will be analysed. First i) was the reported percentage of entities that the respondent expects would read the message. Second ii) was the reported percentage of other entities that the respondent expects would implement the safety behaviour suggested. Third and fourth was the per cent of the time that the respondent themselves expected they would iii) read and iv) implement the message respectively.

Descriptive variables

For RQ5 and RQ6 the analysis is descriptive and not looking at the outcomes of the random allocation but only the descriptive group means.

For RQ5, two variables will be constructed. The first will be constructed from the eight items of the safety behaviour subscale of (Neal, Griffin and Hart, 2000[39]). The eight items will be averaged together to generate an average "behaviour" score with a maximum of 5 and a minimum of 1. Questions included items such as "I carry out my work in a safe manner" and "I ensure the highest levels of safety when I carry out my job". If a respondent did not complete a single item, that item is dropped for that respondent. The second used the four items from the safety motivation subscale from the same questionnaire.[6] The same procedure to generate an average construct score was used. Questions included items such as "I feel that it is important to maintain safety at all times".

For RQ6, we present various descriptive data such as the average age, the geographic distribution of responses (by county of residence), the percentage of English speakers, the experience of the respondent, as well as other relevant data collected to understand the composition of each of the respondent groups.

Analysis

The primary analysis was conducted in the R statistical program. Ordinary least squares (OLS) regressions were used to leverage the individual randomisation and the stratification design – with separate regressions run for the various strata.[7] Due to the limited number of respondents who had been registered for less than 12 months, the 'new' and the 'old' registration strata were merged for both RECs and RGIs.

For each stratum and each outcome, the outcome was regressed on a dummy treatment variable (Equation 1).

Equation 1 $$Y \sim \beta_1 Treatment_{2-1} + \beta_2 Treatment_{3-1}$$

The average treatment effect of being assigned to Treatment Arm 2 instead of Treatment Arm 1 will therefore be given by β_1. The average treatment effect of being assigned to Treatment Arm 3 instead of Treatment Arm 1 will be given by β_2.

In order to test how robust our results were, we conducted additional analysis with covariate adjustments for age and reported non-conformances as shown in Equation 2. These analyse[8] did not substantively change the findings and therefore are not reported but are available upon request.

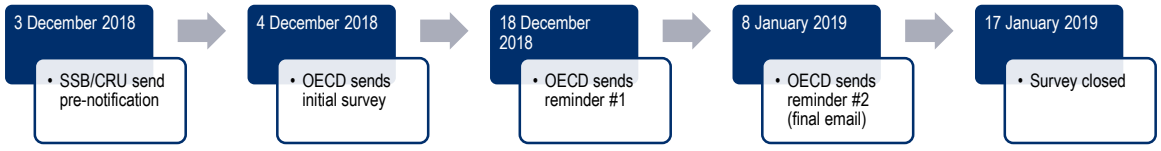
Equation 2 $$Y \sim \beta_1 Treatment_{2-1} + \beta_2 Treatment_{3-1} + \beta_3 Age + \beta_4 NonCon$$

All findings reported below use the first treatment group as the reference group—this is usually the business-as-usual (BAU) group unless otherwise stated.

Timeline

The project timeline is presented in Figure 4.6. A pre-notification email was sent to all potential respondents on Monday 3 December 2018. This pre-notification was sent out by the CRU and the SSB to notify potential respondents that a survey will be sent out on 4 December from the OECD. The next day on Tuesday 4 December 2018 around 11am, the survey email was sent out to approximately 40 staff at the CRU, 40 staff at the SSBs, 1 500 RECs, and 1 500 RGIs. In total, 3 054 emails were sent out of which 117 were undeliverable (57 RECs and 60 RGIs) and 15 opted out. A reminder email was sent on Tuesday 18 December and again on Tuesday 8 January 2019 (both sent between 11am and noon). All responses were anonymous by design using an anonymous link to the Qualtrics-managed survey.

Figure 4.6. Project timeline



Sample characteristics

Responses were accepted from 4 December 2018 through 17 January 2019. In total, 364 potential respondents were asked for their informed consent of whom 96% (n = 349) consented. See full breakdown in Table 4.7. The vast majority (96%, n = 283/296) of RECs and RGIs had been registered more than a year and their average age was 47. Among RECs and RGIs most worked with others (59%, n = 176/296) (herein referred to as firms), and the remainder worked alone (herein individuals).

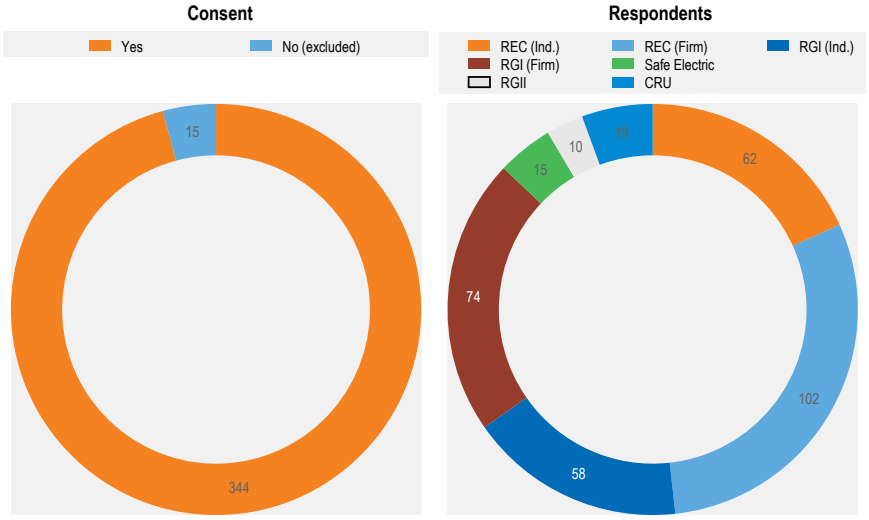
Table 4.7. Survey respondents, by type

Total number of respondents: 349

Entity	Respondents	Percentage of total respondents
RECs	164	47%
RGIs	132	38%
CRU	19	5%
Safe Electric	15	4%
RGII	10	3%

The respondents from the SSBs had been with the SSBs for an average of 8 years and had worked in the sector for an average of 28 years. The respondents from the CRU had worked at the CRU for an average of 6 years and had worked an average of 1 year in the sector prior to joining the CRU. Respondents came from counties throughout Ireland.

Figure 4.7. Consent rates and type of respondent



Results

The salience of safety (RQ1)

RECs and RGIs working alone, are more likely to associate safety with their respective SSBs. When asked what words and concepts respondents associated with either the CRU or the SSBs, those who worked as individual RECs or RGIs were more likely to associate safety with the SSBs rather than the CRU, providing 0.40 ([0.08, 0.71; p = 0.02) and 0.38 ([0.07, 0.69; p = 0.02) more words referencing safety respectively. There were no differences in the frequency of noting safety related terms among RECs or RGIs working within a firm. A combined analysis of staff from the CRU and the SSBs also found that they were more likely to associate the SSBs with safety (B = 0.29 [0.02, 0.56]; p = 0.03). See Table 4.8. An analysis combining all strata also found the same pattern in favour the stronger association of the SSBs with safety (B = 0.27 [0.14, 0.40]; p = 0.00).

Table 4.8. Salience of safety association when selecting THREE descriptors (SSBs vs. CRU)

Strata	N	Contrast	Estimate	Lower CI	Upper CI	P-Value
1_REC_SOLO	36	**SSB – CRU**	**0.40**	**0.08**	**0.71**	**0.02***
2_REC_FIRM	56	SSB – CRU	0.17	-0.1	0.43	0.22
3_RGI_SOLO	35	**SSB – CRU**	**0.38**	**0.07**	**0.69**	**0.02***
4_RGI_FIRM	39	SSB – CRU	0.17	-0.15	0.5	0.29
5_STAFF	42	**SSB – CRU**	**0.29**	**0.02**	**0.56**	**0.03**

The safety effect of primacy and implementation intentions on inspections (RQ2)

Redesigning the report template used by inspectors by placing more common non-conformances earlier in the form and adding an implementation intention resulted in RGIs in firms expecting a higher non-conformance resolution rate among their *peers* (15.73 ppt. [0.00, 31.46]; p = 0.05).[9] Simply re-ordering the report (without the implementation intention) also suggested a higher hypothetical resolution rate (14.01 ppt.), but this latter finding was less precise ([-1.74, 29.76]; p = 0.08). The behaviourally informed redesign of the forms did not have an impact among individual RECs, RECs in firms, or individual RGIs. See Table 4.9. There were no differences when analysing all staff jointly or when analysing all strata together.

Table 4.9. Effects of primacy and implementation intentions in inspection reports on non-conformance resolutions (PEERS)

Strata	N	Contrast	Estimate	Lower CI	Upper CI	P-Value
1_REC_SOLO	51	T2-BAU	-0.13	-12.81	12.54	0.98
		T3-BAU	-13.40	-31.73	4.93	0.15
2_REC_FIRM	81	T2-BAU	-7.85	-19.18	3.47	0.17
		T3-BAU	-3.28	-14.68	8.12	0.57
3_RGI_SOLO	41	T2-BAU	11.90	-8.60	32.40	0.25
		T3-BAU	-0.67	-20.50	19.17	0.95
4_RGI_FIRM	60	***T2-BAU***	***14.01***	***-1.74***	***29.76***	***0.08+***
		T3-BAU	**15.73**	**0.00**	**31.46**	**0.05***

When asked about their *own* hypothetical resolution behaviour, a similar pattern emerged. RGIs in firms were more likely to report that they themselves would resolve the non-conformances when presented with a redesigned inspection report with both re-ordering (primacy) and implementation intentions – although this result lacked precision (15.34 ppt. [-2.08, 32.76]; p = 0.08). Re-ordering alone was insufficient (13.51 ppt. [-3.50, 30.52]; p = 0.12). There were no effects among individual RECs, RECs in firms, or individual RGIs. See Table 4.10. There were no differences when analysing all staff jointly or when analysing all strata together.

Table 4.10. Effects of primacy and implementation intentions in inspection reports on non-conformance resolutions (SELF)

Strata	N	Contrast	Estimate	Lower CI	Upper CI	P-Value
1_REC_SOLO	48	T2-BAU	-11.37	-26.75	4.01	0.14
		T3-BAU	-12.45	-30.27	5.36	0.17
2_REC_FIRM	77	T2-BAU	-6.46	-18.17	5.25	0.28
		T3-BAU	-3.23	-14.84	8.38	0.58
3_RGI_SOLO	41	T2-BAU	-6.46	-24.26	11.33	0.47
		T3-BAU	-9.56	-28.23	9.12	0.31
4_RGI_FIRM	58	T2-BAU	13.51	-3.5	30.52	0.12
		T3-BAU	***15.34***	***-2.08***	***32.76***	***0.08+***

The safety effect of personalisation and implementation intentions on notifications (RQ3)

When considering the effects of a redesign of the non-conformance notices using the original notifications (T1), personalised notifications (T2), and notifications with both personalisation and implementation intentions (T3),[10] effects only emerged among RGIs reporting their *own* hypothetical behaviour. The changes exerted opposing effects on individual RGIs and RGIs in firms. Individual RGIs were *less likely* to answer that they would resolve their non-conformances if they received a personalised notification (T2) when compared to the BAU notice (-13.89 ppt. [-27.37, -0.40]; p = 0.04). Among RGIs in firms, they were *more likely* (+12.65 ppt. [-1.63, 26.94]; p = 0.08) to answer that they would resolve their non-conformances if they were assigned to consider a notification that was both personalised and included implementation intentions. There were no effects among RECs (see Table 4.11). There were no differences when analysing all staff jointly or when analysing all strata together.

Table 4.11. Effects of personalisation and implementation intention in notifications on non-conformance resolution (SELF)

Strata	N	Contrast	Estimate	Lower CI	Upper CI	P-Value
1_REC_SOLO	42	T2-BAU	-3.25	-16.38	9.87	0.62
		T3-BAU	-6.89	-21.31	7.53	0.34
2_REC_FIRM	67	T2-BAU	0.21	-13.29	13.72	0.98
		T3-BAU	0.07	-12.85	12.99	0.99
3_RGI_SOLO	36	**T2-BAU**	**-13.89**	**-27.37**	**-0.4**	**0.04***
		T3-BAU	-6.67	-15.73	2.4	0.14
4_RGI_FIRM	52	T2-BAU	8.26	-7.88	24.4	0.31
		T3-BAU	***12.65***	***-1.63***	***26.94***	***0.08+***

The analysis using reference shifting in which respondents stated how they expected their *peers* to behave upon receipt of the notification revealed no differences between those assigned to the three types of notification. See Table 4.12. There were no differences when analysing all staff jointly or when analysing all strata together.

Table 4.12. Effects of personalisation and implementation intentions in notifications on non-conformance resolution (PEERS)

Strata	N	Contrast	Estimate	Lower CI	Upper CI	P-Value
1_REC_SOLO	45	T2-BAU	2.64	-12.74	18.02	0.73
		T3-BAU	-6.94	-26.18	12.3	0.47
2_REC_FIRM	72	T2-BAU	-0.19	-10.54	10.15	0.97
		T3-BAU	0.74	-10.14	11.63	0.89
3_RGI_SOLO	41	T2-BAU	3.17	-12.2	18.53	0.68
		T3-BAU	-9.41	-26.7	7.88	0.28
4_RGI_FIRM	54	T2-BAU	5.67	-7.57	18.91	0.39
		T3-BAU	3.21	-9.79	16.21	0.62

The safety effect of messengers (RQ4)

The study next considered the effect of the messenger when receiving safety information from either the CRU (T1), their SSB (T2), or their peer trainer (T3). Once again, respondents were asked to consider how their peers would respond and how they would respond. They were asked both how likely it would be that their peers (or themselves) would read the information and separately how likely they would be to implement the suggestion.

When considering their *peers* reactions, RGIs in firms assigned to the scenario with a peer as the messenger suggested that other RGIs would be 15 ppt. more likely to read such information ($p = 0.052$) and 22 ppt. more likely to implement the suggestion ($p = 0.004$). There were no messenger effects for the other three groups (individual RECs, RECs in firms, and individual RGIs). See

Table 4.13. There were no differences when analysing all staff jointly or when analysing all strata together.

Table 4.13. Effects of messengers for reading and acting on safety improvement suggestions (PEERS)

Strata	N	Contrast	Estimate	Lower CI	Upper CI	P-Value
PEERS would READ						
1_REC_SOLO	43	SSB-CRU	15.50	-5.64	36.64	0.15
		TRAINER-CRU	11.96	-7.95	31.87	0.23
2_REC_FIRM	69	SSB-CRU	-1.30	-17.52	14.93	0.87
		TRAINER-CRU	1.11	-12.20	14.42	0.87
3_RGI_SOLO	36	SSB-CRU	8.97	-4.42	22.37	0.18
		TRAINER-CRU	-5.87	-23.34	11.60	0.50
4_RGI_FIRM	52	SSB-CRU	6.63	-9.77	23.03	0.42
		TRAINER-CRU	**15.11**	**-0.11**	**30.33**	**0.05***
PEERS would ACT						
1_REC_SOLO	43	SSB-CRU	7.67	-13.66	28.99	0.47
		TRAINER-CRU	-3.79	-24.84	17.25	0.72
2_REC_FIRM	69	SSB-CRU	-3.33	-19.94	13.27	0.69
		TRAINER-CRU	-0.56	-15.04	13.93	0.94
3_RGI_SOLO	36	SSB-CRU	6.92	-9.03	22.87	0.38
		TRAINER-CRU	-5.80	-27.44	15.84	0.59
4_RGI_FIRM	53	***SSB-CRU***	***13.12***	***-1.49***	***27.74***	***0.08+***
		TRAINER-CRU	**21.54**	**7.09**	**36.00**	**0.00*** **

When considering their *own* hypothetical reactions, RGIs in firms assigned to the peer-trainer messenger still reported the highest likelihood of reading and implementing the suggestion compared to the RGIs in firms assigned to scenarios with either the CRU (T1) or their SSB (RGII) (T2) as the messenger. However, the finding was no longer statistically significant for either reading (+8 ppt.; p = 0.28) or implementing the suggestion (+11 ppt.; p = 0.24). However, among RECs in firms, the opposite pattern emerged—they were 12 ppt. more likely to report that they would implement the suggestion when assigned to receiving the message from the CRU compared to from their peers (p = 0.09). Although the finding lacked precision, the same pattern was manifest among RECs in firms and the likelihood that they read the message, with those assigned to the CRU messenger scenario having the highest point-estimate likelihood of their reading the message—7 ppt. higher than the SSB (Safe Electric) messenger (p = 0.35) and 6 ppt. higher than the peer messenger (p = 0.32). See Table 4.14. There were no differences when analysing all staff jointly or when analysing all strata together.

Table 4.14. Effects of messengers for reading and acting on safety improvement suggestions (SELF)

Strata	N	Contrast	Estimate	Lower CI	Upper CI	P-Value
PEERS would READ						
1_REC_SOLO	43	SSB-CRU	6.33	-16.24	28.91	0.57
		TRAINER-CRU	10.92	-6.74	28.57	0.22
2_REC_FIRM	69	SSB-CRU	-6.85	-21.47	7.77	0.35
		TRAINER-	-5.97	-17.86	5.92	0.32

Strata	N	Contrast	Estimate	Lower CI	Upper CI	P-Value
		CRU				
3_RGI_SOLO	36	SSB-CRU	0.26	-8.32	8.84	0.95
		TRAINER-CRU	-3.99	-14.60	6.62	0.45
4_RGI_FIRM	52	SSB-CRU	0.74	-15.52	16.99	0.93
		TRAINER-CRU	8.22	-6.90	23.35	0.28
PEERS would ACT						
1_REC_SOLO	43	SSB-CRU	-2.50	-23.18	18.18	0.81
		TRAINER-CRU	-5.83	-26.74	15.07	0.58
2_REC_FIRM	69	SSB-CRU	-10.74	-26.60	5.12	0.18
		TRAINER-CRU	***-11.67***	***-25.11***	***1.77***	***0.09+***
3_RGI_SOLO	36	SSB-CRU	1.99	-11.30	15.27	0.76
		TRAINER-CRU	-0.21	-14.56	14.14	0.98
4_RGI_FIRM	52	SSB-CRU	1.68	-16.55	19.92	0.85
		TRAINER-CRU	10.78	-7.34	28.89	0.24

The safety behaviour and motivation of entities (RQ5)

The self-reported safety behaviour scores were high—and very near to their maximum. The mean safety behaviour was 4.53 for the full sample. The only statistically significant difference between subgroups was that Safe Electric staff reported higher levels of safety behaviour than did staff at the CRU (B = 0.573 [95% CI 0.009; 1.137]).

The self-reported safety motivation scores were similarly high. The mean safety motivation score was 4.70 for the full sample. The only statistically significant difference between subgroups was that the Safe Electric staff reported higher safety motivation than did RECs within firms (B = 0.121 [0.013, 0.229]). Although imprecise, the staff at Safe Electric also had higher safety motivation than staff at the CRU (B = 0.595 [-0.024, 1.214]).

The respondents' characteristics (RQ6)

RECs and RGIs were on average 47 years old and included respondents from all 31 counties. Almost all respondents reported speaking English at home, other languages spoken at home included Irish, Swahili, German, and Latvian. Twenty-nine per cent reported having had at least one non-conformance in their most recent inspection. Most respondents (75%) believe that the SSBs and the CRU contribute to safety. However, respondents estimate that approximately a third (35%) of all electrical or gas works are done illegally.

When considering how they would prefer to receive and report information, there is a preference for electronic communication.

Among SSB respondents, the average age was 50. Respondents had extensive experience, with an average of 8.3 years working for the SSB and an average of 28.3 years in the field. Respondents believe that the SSBs and the CRU are working towards the same goals 65% of the time. Respondents believe that inspectors usually apply the same codes of severity to non-conformances but there remains a minority that does not (27% for Safe Electric and 17% for RGII).

Among staff from the CRU, the average age was 35 and respondents had an average of 6 years of experience working at the CRU and an average of 1.4 years of experience in the industry prior to joining the CRU. Respondents felt that the SSBs and the CRU were working toward the same goals 65% of the time (the same as the SSB respondents). While respondents report a good understanding of the CRU's role in regulating safety and strongly believe that the CRU is open to hearing new ways to improve, there was a lower level of agreement about how effective the CRU has been in regulating the gas and electricity sector.

Summary findings

The study revealed several key findings by comparing the different responses of respondents who were randomly allocated to different scenarios designed to investigate the potential impact of behavioural insights. The study also collected key descriptive information about the safety schemes. Respondents were grouped as 1) RECs working individually; 2) RECs working in firms; 3) RGIs working independently; 4) RGIs working in firms; 5) Safe Electric staff; 6) RGII staff; and 7) the CRU staff. Respondents were randomised within groups and we focus primarily on the results for the regulated entities (the first four groups). The following provides a summary of key findings.

- The different groups ('strata') showed different results, indicating the **importance of targeting behaviourally informed interventions** differently with the groups.
- Individual RECs and individual RGIs who were randomly allocated to reply with the three words they associate with the SSBs were more likely to list words associated with safety than the group of respondents who listed words associated with the CRU. This revealed that **RECs and RGIs working individually are more likely to associate SSBs with safety than to associate the CRU with safety**—sharing 0.40 and 0.38 more safety related words respectively for SSBs on average.
- **Safety behaviour and safety motivation among respondents were high**. The full sample had an average of 4.58 and 4.70 respectively on a 5-point scale. The staff of the CRU reported the lowest safety behaviour and safety motivation (4.19 and 4.38 respectively) while Safe Electric reported the highest levels (4.77 and 4.98).

The study also tested several scenarios in which the inspection report and the non-conformance notice included or excluded behavioural insights. Respondents were assigned to three groups. For reports, one group was presented with the current report, the second group was presented a version of the report that applied *primacy* by moving inspection areas with common non-conformances to the beginning of the form,[11] and the third group was shown a report that included *primacy* combined with a prompt to make a specific plan for addressing any non-conformance (an *implementation intention*).

For the notice, group one saw the current version, group two was shown a more *personalised* version, and group three was shown a notice that combined the *personalisation* with an *implementation intention*.

Finally, the three groups were randomly assigned to scenarios in which safety messages were received from either the CRU, the SSB, or a trainer in order to test *messenger effects*.

- The experiment found that combining *primacy* and *implementation intentions* in inspection reports improved the expected likelihood of resolving non-conformances (+15 ppt. for themselves to +16 ppt. for peers), but only among RGIs who work in firms. Other types of respondents showed no impact from the changes.
- For notices, RGIs in firms were also more likely to expect timely resolutions of non-conformances when they were presented with notices that used both *personalisation* and *implementation intentions* (+13 ppt.). Individuals working alone as RGIs expected *worse* resolution rates with personalised notifications (-14 ppt.). Other types of respondents did not experience any impact.

- Finally, RGIs in firms were also more likely to incorporate suggestions to improve safety if the messenger was a previous trainer (+15 ppt.). RECs in firms responded more favourably to messages from the CRU (+12 ppt.) compared to trainer.

Implications for safety policy

The following section summarises the findings according to each of the research questions.

> **RQ1**: How salient is the association of safety with actors and activities associated with the schemes? How do they differ among respondents?

Finding: SSBs are more closely associated with safety than the CRU—especially among RECs and RGIs who are working individually (not in firms). This may be due to the closer interaction between individual RECs and RGIs and their respective SSBs. Interestingly, this was also true for the staff of the CRU who were more likely to choose words associated with safety when they were assigned to describe the SSBs than when they were assigned to describe the CRU.[12]

Implication: Given the prominent role of the SSBs, this finding appears to confirm that the regulatory safety scheme in Ireland is associated with the SSBs—with RECs, RGIs, and the CRU all being more likely to associate SSBs with safety than to associate the CRU with safety. This may point to the need for additional awareness raising of the role of the CRU regarding safety among RECs and RGIs working individually to help better associate the CRU with safety.

> **RQ2**: Would a more behaviourally informed INSPECTION REPORT increase the accurate identification and timely resolution of non-conformances?

Finding: The behaviourally informed changes only had an impact on RGIs in firms. This group reported higher expected rates of resolving non-conformances when assigned to the group that viewed a revised inspection report in which common non-conformances were moved earlier in the inspection report (primacy) *and* implementation intentions were also added. This was true when they reported based on their own predicted behaviour and that of their peers. When considering their peers, only changing the order of inspection items (primacy) also had an impact on expected non-conformance resolution rates, albeit with less precision.

Implication: New inspection forms that are re-ordered based on common violations and include an implementation intention planning prompt can have a positive effect on RGIs in firms and should not have any negative effect on RGIs who work on their own. Accordingly, new forms should be field tested with RGIs measuring observed behaviour. There does not seem to be any added value in changing the REC report form along the lines of the tested behavioural insights.

> **RQ3**: Would a more behaviourally informed NON-CONFORMANCE NOTIFICATION sent after an inspection regarding any identified non-conformances result in a better predicted response rate?

Finding: RGIs were impacted by the behaviourally informed changes to the non-conformance notice; however, these effects differed dramatically between RGIs in firms and RGIs working individually. RGIs working individually reported the highest non-conformance resolution rates with the current business-as-usually notice and the *worst* rates with the personalised notice. RGIs working in firms showed the *best* expected rates of resolution if they were shown the notice with both personalisation *and* implementation intention. This may suggest that RGIs who are working individually may feel that personalisation raises privacy concerns while firms expect to have their details used in correspondence.

Implication: The notification of non-conformances should be differentiated for RGIs working individually and those working in firms. For individuals it may be counter-productive to include personalisation while for RGIs in firms a new notice combining personalisation and an implementation intention should be tested and potentially rolled out. For both groups, it may be useful to test combining implementation intentions with a different behavioural insight, such as feedback.

RQ4: How does the originating organisation (the messenger) who sends a message about safety shift the predicted response of the community of regulated entities (RECs/RGIs)?

Finding: The effect of different messengers on the likelihood of attending to and implementing non-binding suggestions for improved safety was noted for RGIs working in firms.[13] RGIs in firms were more likely to read and implement suggestions coming from the person who had previously trained them (a more experienced peer).

Implication: This suggests that RGII and the CRU should consider putting in place systems for trainers to keep in contact with RGIs who work in firms and to utilise these individuals to deliver safety related suggestions. Such a change could be as simple as obtaining permission from trainers to use their likeness and names in subsequent communication materials that are sent to the RGIs they trained. However, this change should not be done for RGIs working individually because such a strategy seems to be ineffective and there is a risk that the effect may even be negative for this group. Therefore reliable systems for targeting RGIs working alone and those working in firms separately should be put in place.

RQ5: What is the level of safety behaviour and motivation among the respondents? How do they differ by type of respondent?

Finding: The level of safety behaviour and safety motivation reported were extremely high among all types of respondents. In all cases the average self-reported rating was over 4 on a 5-point scale. Safe Electric staff had the highest safety motivation (4.98) and safety behaviour (4.77) and the CRU staff had the lowest (4.38 and 4.19 respectively).

Implication: Using this limited metric, the safety behaviour and safety motivation in the sector appears to be high. However, the metric is not sufficiently sensitive and future research should identify more sensitive measures considering the fact that 29% of RECs and RGIs reported having a non-conformance in the previous year.

Conclusions

Together, these findings highlight the importance of taking into consideration issues related to individuals' understanding and capacity of relating to and absorbing information when designing regulatory and enforcement schemes. It also highlights the importance of tailoring behaviourally informed interventions for different populations and avoiding broad generalisations. Findings also suggest that most of the tested behaviourally informed changes (primacy, personalisation, implementation intentions, and experienced peer messengers who previously conducted training) would be effective for RGIs working in firms but not for the other respondent groups. The study also illustrates the utility of testing behavioural principals and their effect on safety related processes and procedures through a stratified survey experiment prior to testing changes in practice.

Results from the study suggest that the CRU and RGII consider a field trial to further test the effects of these behaviourally informed adjustments for RGIs working in firms in Ireland while measuring observed non-conformances. For the other groups, results suggest that further behavioural principles be tested. For example, considering the potential negative effect of personalisation among individual RGIs and RECs, future tests could remove personalisation and attempt to pair implementation intentions with another behavioural insight, such as feedback—which showed promise in the Phase I study.

Together, the two phases of this project demonstrate the value of the iterative testing approach that is foundational to the behavioural insights methodology. This was especially true when comparing comparative to national-level results, which gives encouragement to other countries to engage in further research to gain a more holistic understanding of the drivers of safety culture in the energy sector. This study has also highlighted the potential for the continuous testing and improvement of the procedures and communications through the application of behavioural insights within the safety schemes.

Notes

[1] The time given to resolve a non-conformance ranges from 24 hours for severe non-conformances to within 21-days for less severe non-conformances.

[2] Some electricians work under a registered REC who is responsible for certifying their electrical works.

[3] As noted below, this stratification variable was collapsed because so few respondents were in the scheme for less than 12 months.

[4] The study was reviewed and exempted by the Teachers College, Columbia University ethical review board (Protocol #19-069) and the analysis plan for the primary results was registered with the American Economics Association's Social Science Trial Registry (#0003796) prior to downloading and analysing the survey data. This process follows best practice research protocols that are adhered to when conducting experiments involving samples of individuals.

[5] Note that for each respondent percentages were rounded to the nearest 10 digit to reduce variance that is unlikely to be meaningful for the respondent.

[6] While safety culture has many more facets beyond behavior and motivation, we prioritised creating a concise survey that would encourage higher respondent engagement instead of using a longer tool

[7] We originally planned to conduct an overall test across all strata; however, because different pre-specified strata reacted differently (even in opposite reactions) we primarily report the results by strata and only briefly note the results of the model that includes all groups with strata as a control variable.

[8] The study was reviewed and exempted by the Teachers College, Columbia University ethical review board (Protocol #19-069) and the analysis plan for the primary results was registered with the American Economics Association's Social Science Trial Registry (#0003796) prior to downloading and analysing the survey data. This process follows best practice research protocols that are adhered to when conducting experiments involving samples of individuals.

[9] See Annex 4.B for the version of the inspection reports tested with the three respondent groups.

[10] See Annex 4.B for notices presented to the three different respondent groups.

[11] Common non-conformances were identified using previous quarterly reports from the SSBs.

[12] This may be due, in part, to the wider remit of the CRU.

[13] The primary trend was among RGIs in firms in favour of peer-trainers as messengers. However, RECs in firms did show some preference for messages being sent by the CRU instead of a peer-trainer.

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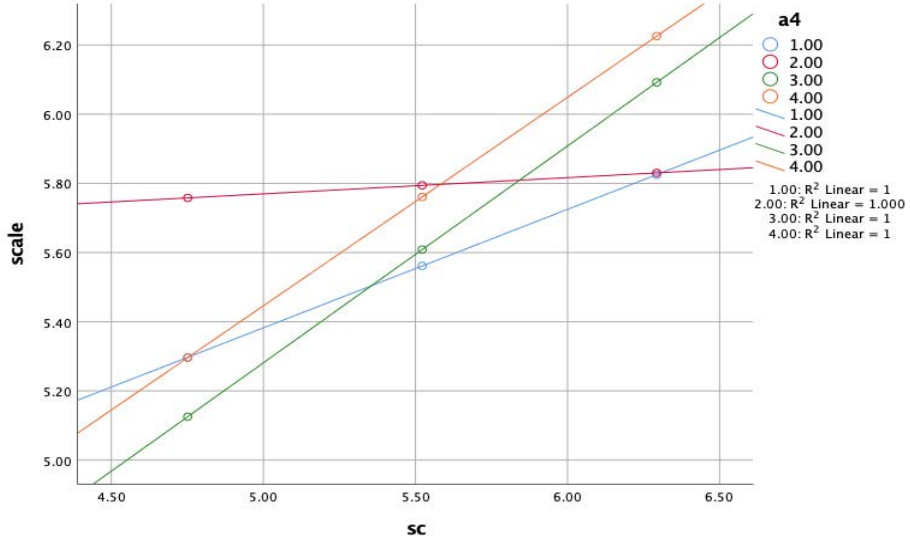
Annex 4.A. Data from country analysis in Phase 1

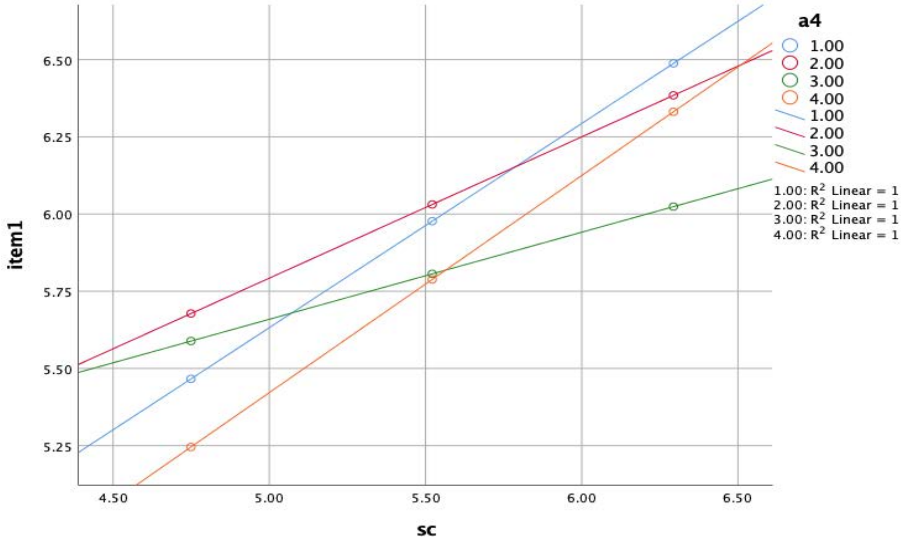
Ireland: Results of safety culture by occupational role moderation on vignette effectiveness

Annex Figure 4.A.1. The effect of safety culture (sc) on overall vignette effectiveness (scale) at levels of occupational role



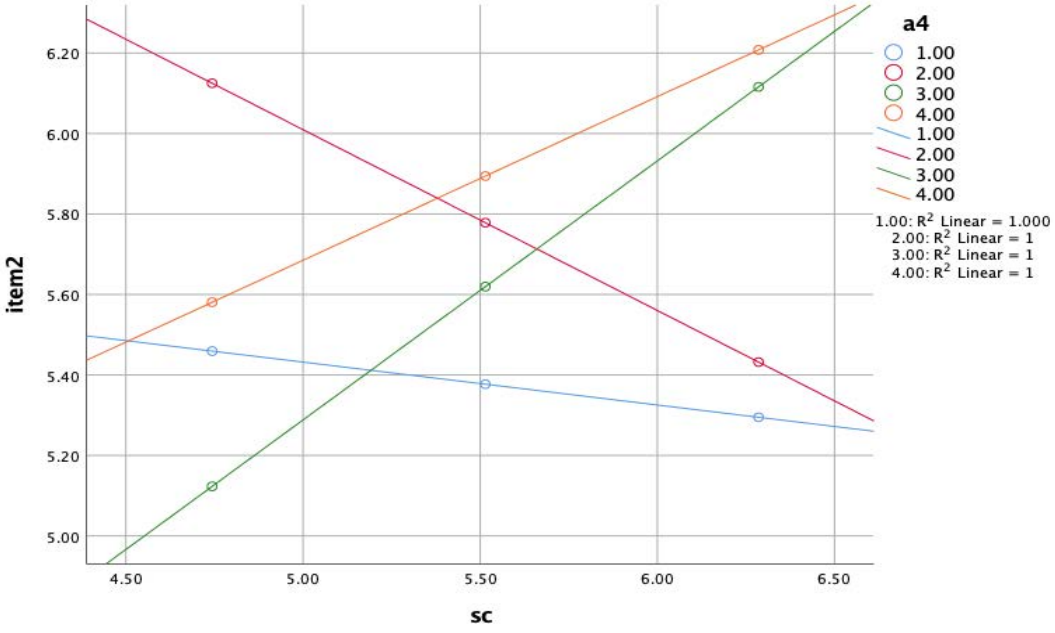
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.2. The effect of safety culture (sc) on vignette effectiveness for attracting attention of workers (item1) at levels of occupational role



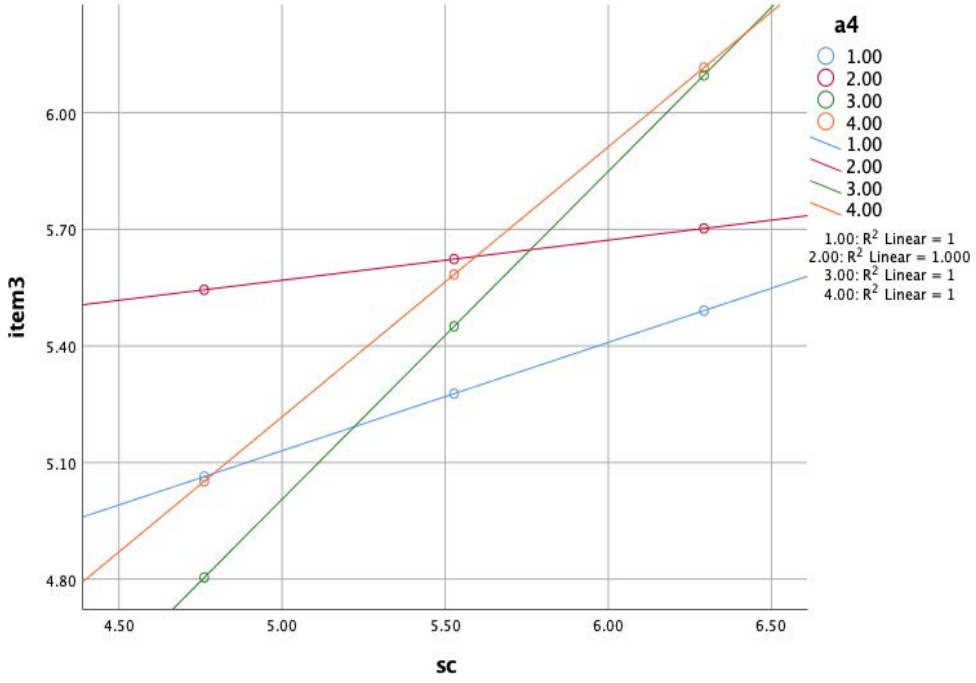
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.3. The effect of safety culture (sc) on whether vignette should affect behaviour of workers (item2) at levels of occupational role



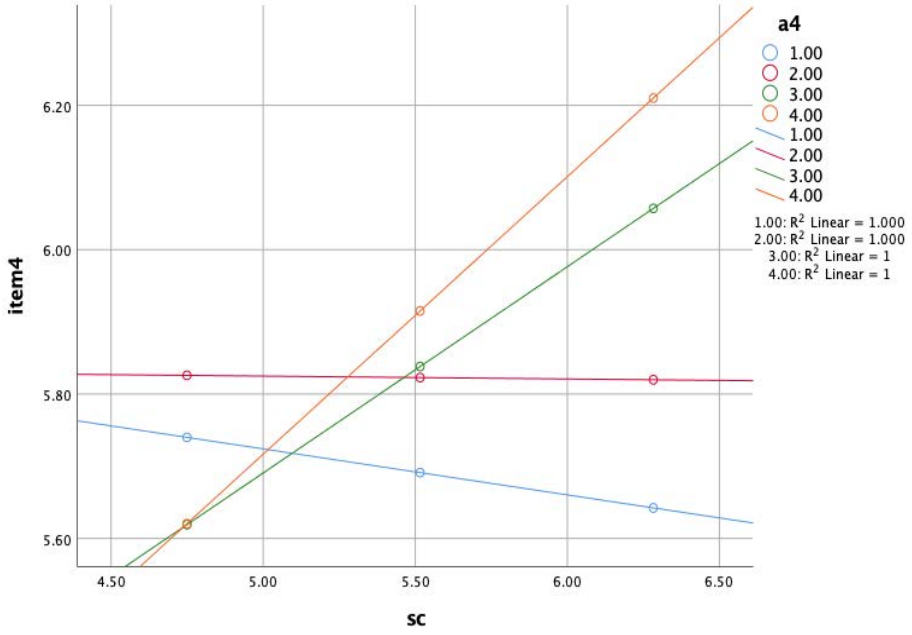
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.4. The effect of safety culture (sc) on whether vignette would affect behaviour of workers (item3) at levels of occupational role



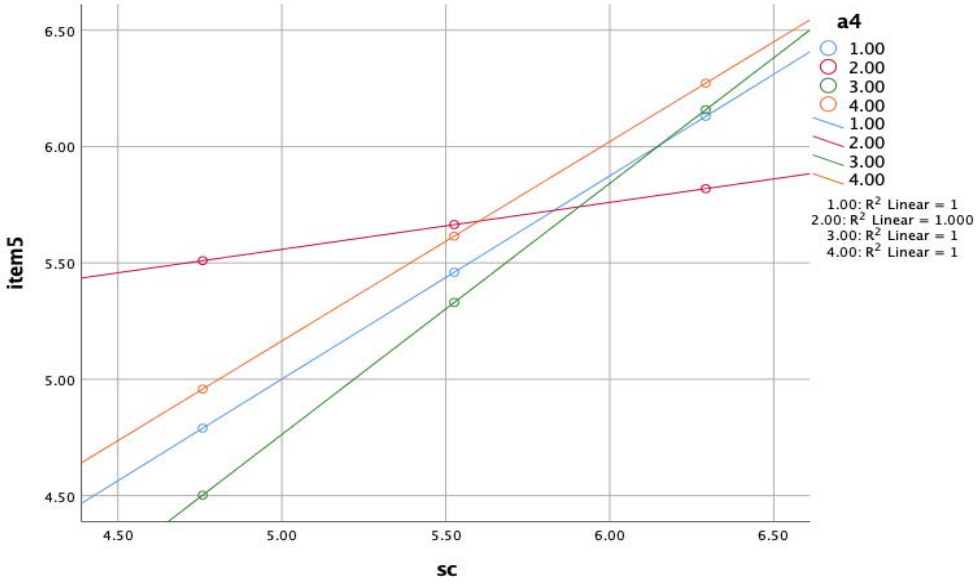
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line).The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.5. The effect of safety culture (sc) on whether vignette should affect behaviour of managers/the entity overall (item4) at levels of occupational role



Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

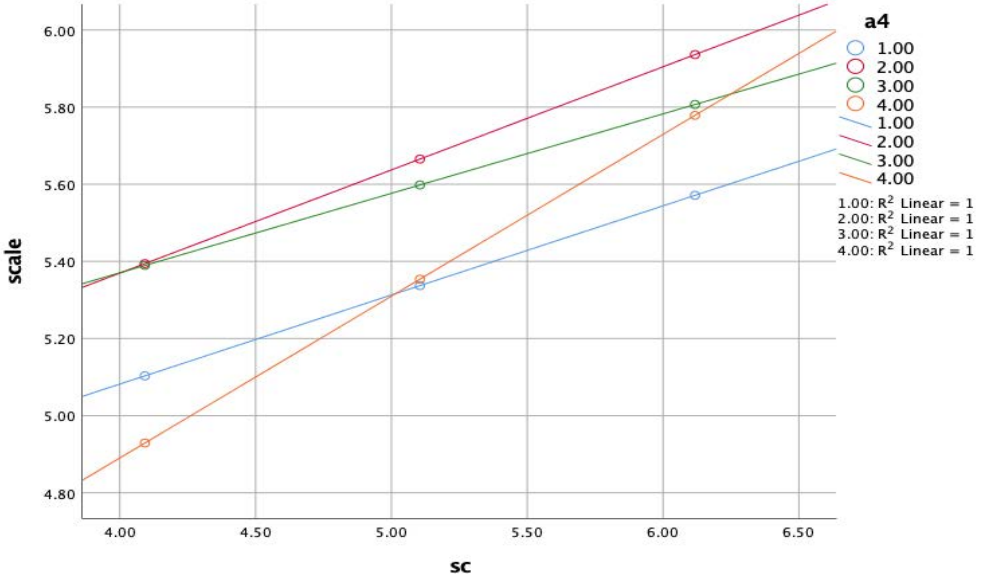
Annex Figure 4.A.6. The effect of safety culture (sc) on whether vignette would affect behaviour of managers/the entity overall (item5) at levels of occupational role



Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

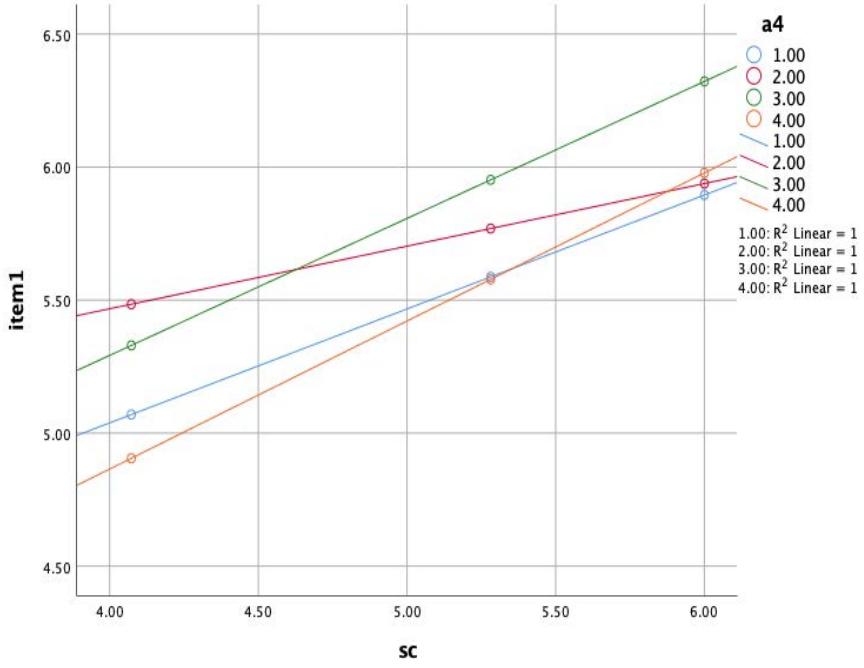
Mexico: Results of safety culture by occupational role moderation on vignette effectiveness

Annex Figure 4.A.7. The effect of safety culture (sc) on overall vignette effectiveness (scale) at levels of occupational role



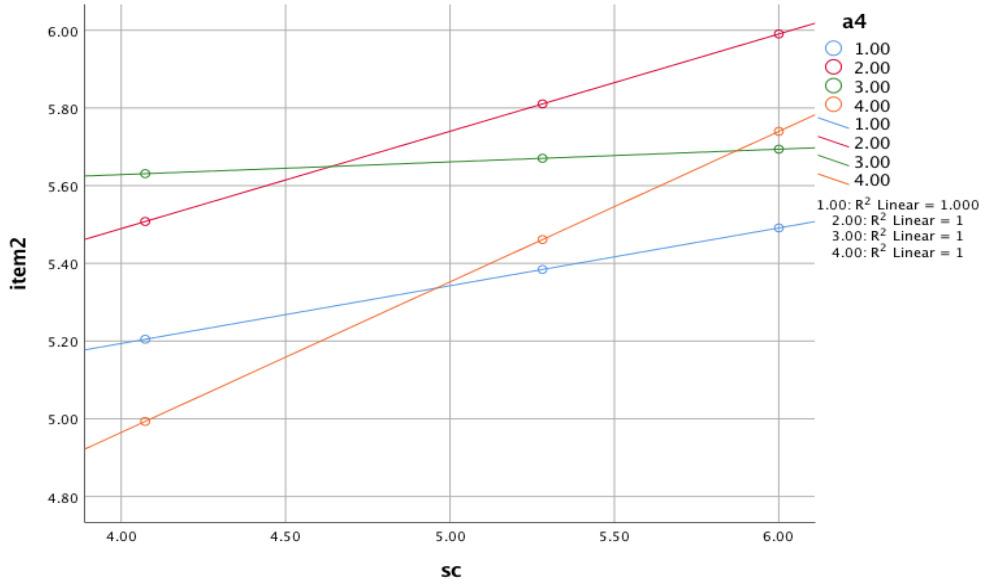
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.8. The effect of safety culture (sc) on vignette effectiveness for attracting attention of workers (item1) at levels of occupational role



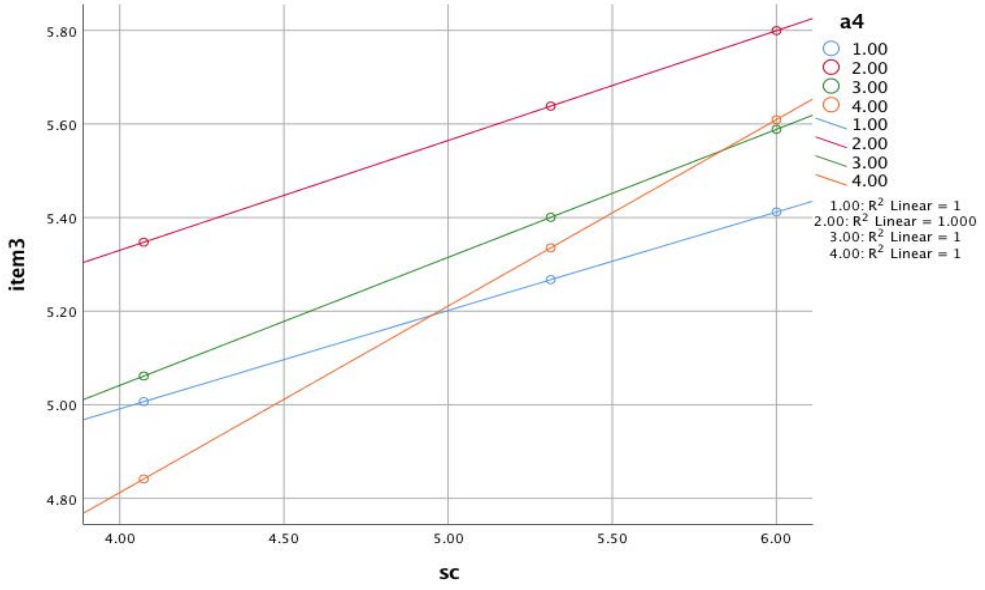
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.9. The effect of safety culture (sc) on whether vignette should affect behaviour of workers (item2) at levels of occupational role



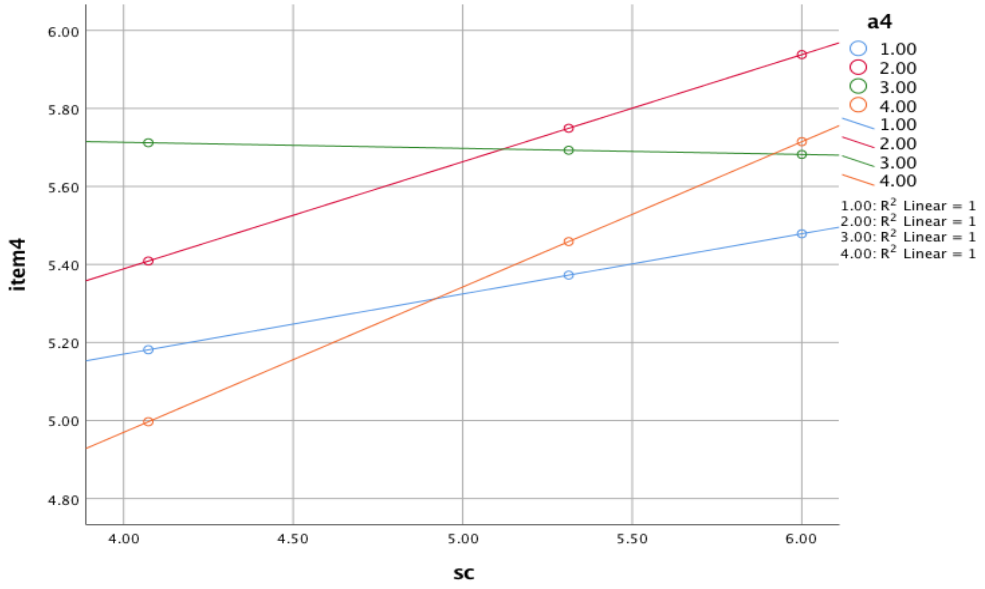
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line)). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.10. The effect of safety culture (sc) on whether vignette *would* affect behaviour of workers (item3) at levels of occupational role



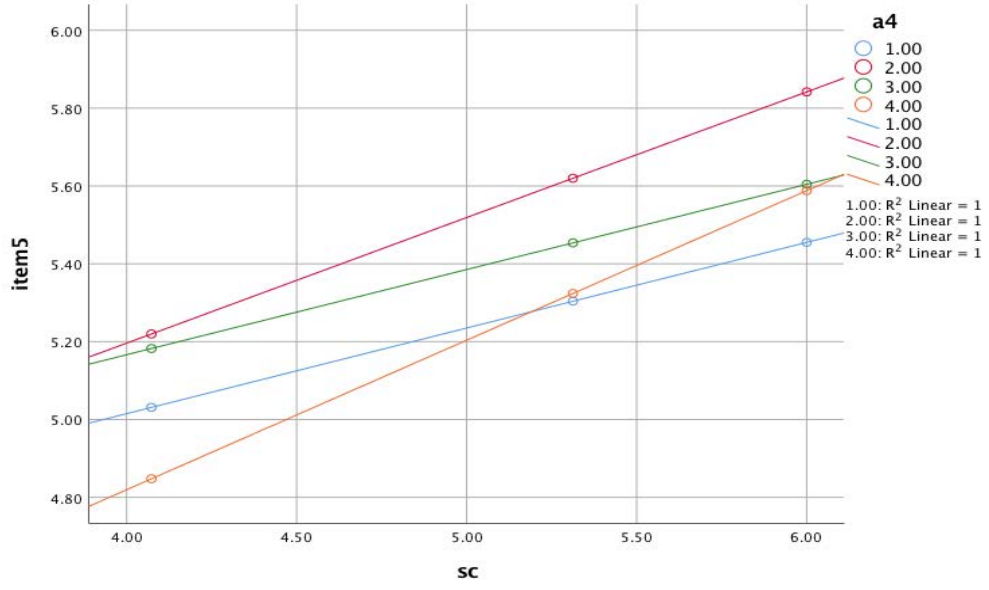
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.11. The effect of safety culture (sc) on whether vignette *should* affect behaviour of managers/the entity overall (item4) at levels of occupational role



Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

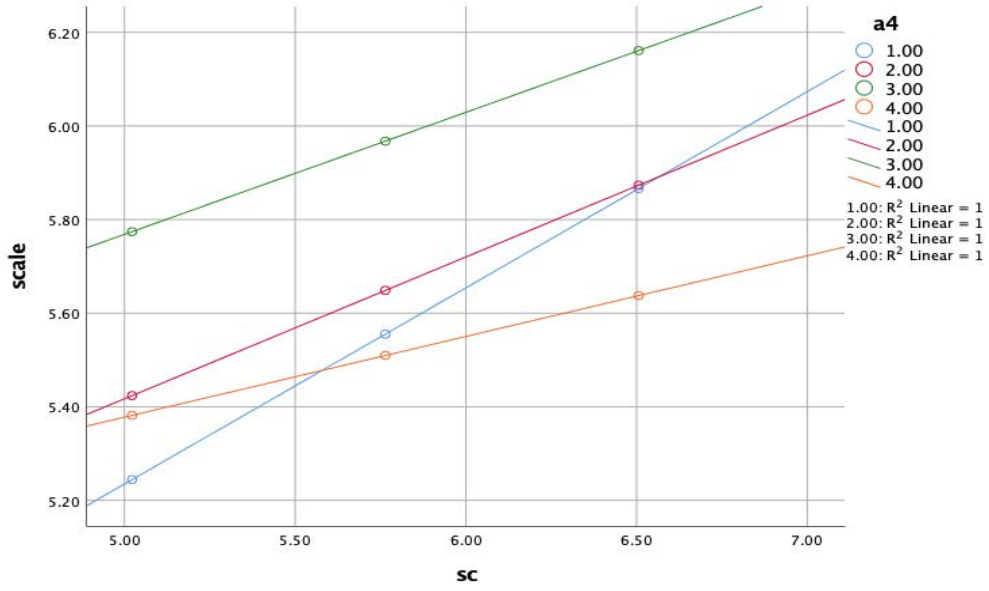
Annex Figure 4.A.12. The effect of safety culture (sc) on whether vignette would affect behaviour of managers/the entity overall (item5) at levels of occupational role



Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line)). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

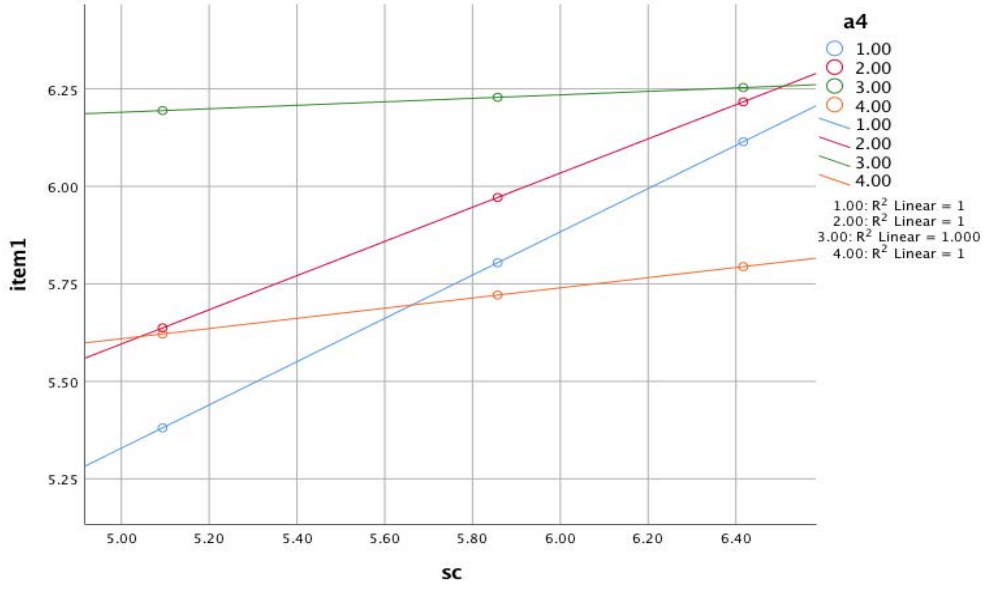
Oman: Results of safety culture by occupational role moderation on vignette effectiveness in Oman

Annex Figure 4.A.13. The effect of safety culture (sc) on overall vignette effectiveness (scale) at levels of occupational role



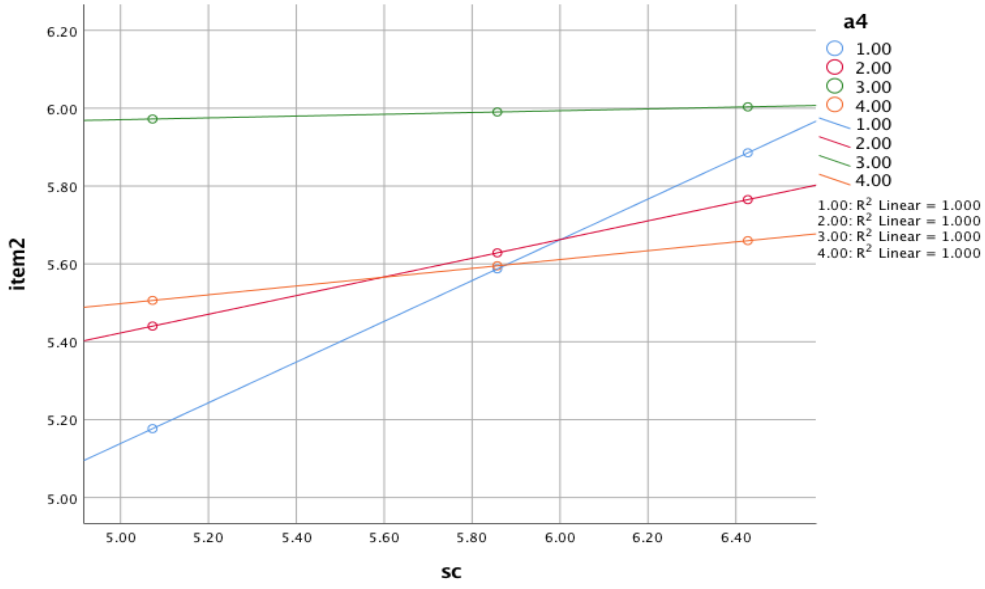
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.14. The effect of safety culture (sc) on vignette effectiveness for attracting attention of workers (item1) at levels of occupational role



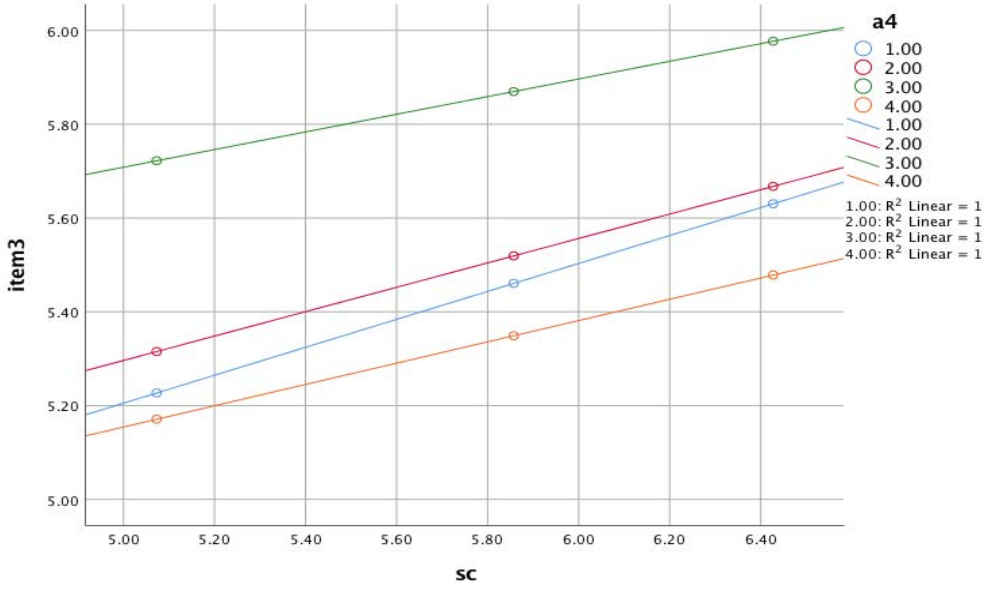
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.15. The effect of safety culture (sc) on whether vignette should affect behaviour of workers (item2) at levels of occupational role



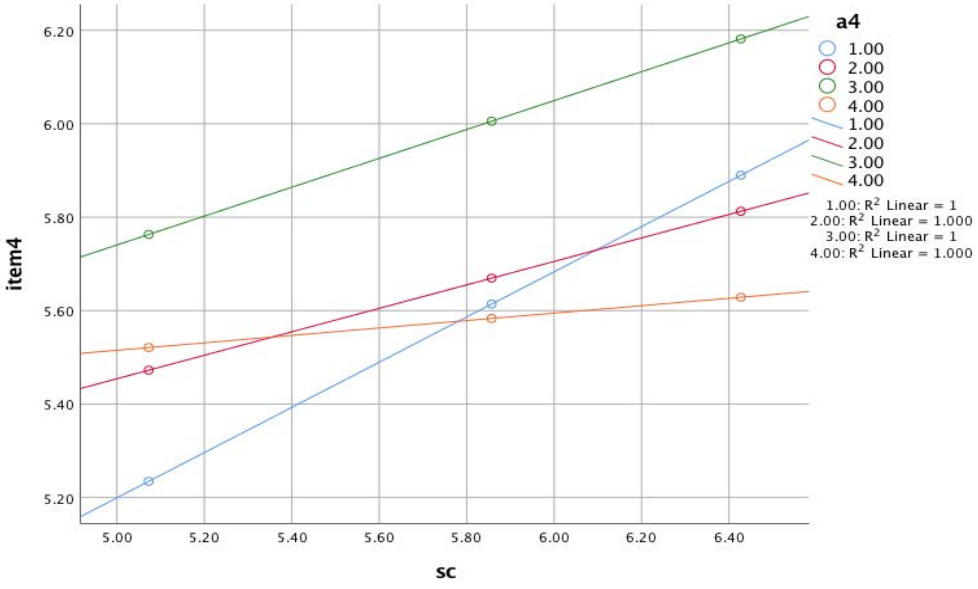
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.16. The effect of safety culture (sc) on whether vignette would affect behaviour of workers (item3) at levels of occupational role



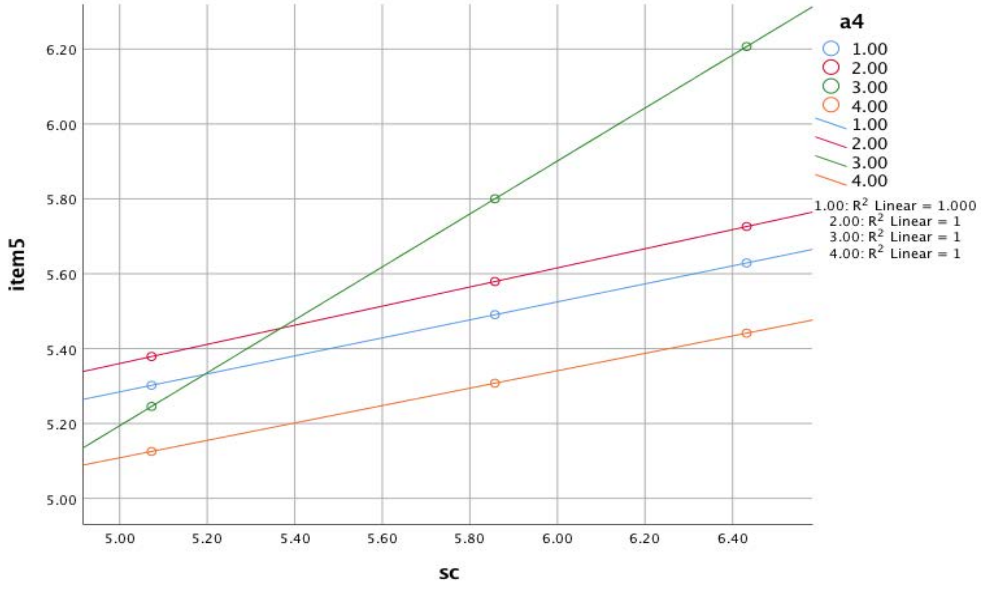
Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.17. The effect of safety culture (sc) on whether vignette should affect behaviour of managers/the entity overall (item4) at levels of occupational role



Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex Figure 4.A.18. The effect of safety culture (sc) on whether vignette would affect behaviour of managers/the entity overall (item5) at levels of occupational role



Note: a4: 1 frontline staff (blue line); 2 managers (red line); 3 senior managers (green line); or 4 other staff (orange line). The steeper a line, then the more that occupational role is affected by the perceived culture of the entity in estimated the effectiveness of the vignettes.

Annex 4.B. Additional information from Phase 2

Research questions

Annex Table 4.B.1. Research questions

Research question	Rationale	Experimental arms		
		Arm #1	Arm #2	Arm #3 (RECs and RGIs only)
RQ1. How salient is the association of safety with actors and activities associated with the schemes? How do they differ among respondents?	The focus on following procedures and standards may crowd out the salience of the focus on safety and replace it with a more bureaucratic focus on rule-following which could weaken safety culture. *Behavioural insight(s): salience, priming*	Prime: CRU	Prime: SSB	N/A
RQ2. Would a more behaviourally informed INSPECTION REPORT increase the predicted accurate identification and timely resolution of non-conformances?	The current report format has a different design for RECs and RGIs, even in elements that share content (such as sections for basic information, non-conformances, and signatures). This difference might account for a proportion of the differences in rates of non-conformance identification and resolution. Making use of the colour coding and primacy effects (what is presented at the beginning, middle, and bottom of the page) or an implementation intention (an explicit action plan) could shift the prioritisation of inspectors and the understanding of RECs/RGIs. *Behavioural insight(s): primacy, implementation intentions*	Control (BAU)	Default Order Changed to Test Primacy Effects (Primacy)	Prompted Implementation Intention Commitment Added (Primacy + Implementation Intention)
RQ3. Would a more behaviourally informed NON-CONFORMANCE NOTICE sent after an inspection regarding any identified non-conformances result in a better predicted response rate?	The current notice is generic and does not contain many of the common best practices for behaviourally informed communication designed to improve behavioural follow-through—such as personalisation and clear action steps. This survey can provide an initial test of the predicted effect of a change in design on hypothetical behaviour that could inform a change in the notices used by the SSBs. *Behavioural insight(s): salience, personalisation, implementation intentions*	Control (BAU)	Increased Salience & Ease of Use Through Personalisation (Personalisation)	Prompted Implementation Intention Commitment Added (Personalisation + Implementation Intention)
RQ4. How does the originating organisation who sends a message about safety shift the predicted response of the community of	Messages may be more salient if they come from an authoritative governmental body (the CRU), a known and trusted organisation with direct responsibility for the scheme (SSB), or a peer with more social	Messenger: CRU	Messenger: SSB	Messenger: Peer (trainer)

Research question	Rationale	Experimental arms		
		Arm #1	Arm #2	Arm #3 (RECs and RGIs only)
regulated entities (RECs/RGIs)?	proximity and perceived expertise (a REC / RGI who previously trained them). If the community is more responsive to a particular messenger, that information could shift the design, branding, and dissemination of key resources and messages. *Behavioural insight(s): salience, messenger effects*			
RQ5. What is the level of safety behaviour and motivation among the respondents? How do they differ by type of respondent?	First, this information will provide a descriptive overview of the safety culture and safety environment in the sector. Second, this information will enable us to investigate the degree to which these variables differ among the various respondent groups (i.e. the RECs, RGIs, the CRU, and the SSBs).	n/a	n/a	n/a
RQ6. What are the demographic characteristics of the respondents?	Similarly to RQ5, this information will provide a descriptive overview and enable us to investigate if there are unique interactions between demographics and observed results.	n/a	n/a	n/a

REC Reports

Annex Figure 4.B.1. Group 1 (Business-as-Usual)

Safety Supervisory Body - Inspection Report

FORM R07B Rev:7I

Inspector's Name:		Order No:		Date of Inspection:	/ /
Name of REC:				Reg. No.:	
Installation Visited				Installation Certified:	No ☐ Yes ☐ Pre ☐ Post ☐
Name:				MPRN:	1 0
Address:				Compl Cert No:	
				Test Sheet Available:	Yes ☐ No ☐
				Test Sheet Number:	Seal No:
Energised:	Yes ☐ No ☐		ET101 Rules Applicable:	Current Edition ☐	Previous Edition ☐ (Clarify reason why used below)
Category:	Domestic ☐ Agri ☐ Commercial ☐ Industrial ☐			Other:	
Installation Type:	New ☐ Rewire ☐ Addition ☐ Re-Connection ☐ NSH ☐			Builders Supply ☐	Other:
Installation Status:	First Fix ☐ Second Fix ☐		Inspection Type:	Visual Only ☐	Visual & Sample testing ☐

O/D	No	N/A	♦	♦= Ongoing / not checked due to limitations on site (see comments)
				Supply Interface
				Main protective device correct
				ESBN interface requirements correct
				SSB Seal fitted *(CRU CP1 - 6.3)*
				Main isolation complied with
				Earthing and Bonding
				Main protective conductor correct
				Main water bonded
				Main gas bonded
				Structural steel bonded
				Correct size cable for bonding
				Earth Electrode
				Earth electrode connection accessible and connected
				Correct size cable for main earth conductor
				Protective tape used *(542.3.2)*
				Supplementary / Extraneous
				Metal sinks comply with 544.2.8
				Bathrooms comply with 701.544.04
				Metal frame walls and ceilings containing wiring bonded
				Metal socket/switch boxes earthed

Note: Checked (CKD) does not confirm compliance with ET101

O/D	No	N/A	♦	
				Distribution boards and protection devices
				Located correctly *(530.5)*
				Distribution boards correctly labelled *(530.5.12 & 531.2.2.2)*
				Correct overload protection
				RCD protection complies with ET101
				Neutral and protective conductors in correct sequence (530.5.12)
				Wiring System
				Correct cable core colours
				Correct cable size used
				Satisfactory mechanical protection & routing of cables
				Accessories, Fittings & Equipment
				IP rating correct
				Mounting heights correct
				Local - Maintenance isolators provided
				Outcome of random sample testing
				Loop impedance satisfactory
				RCDs / RCBOs operating to required parameters
				Insulation resistance satisfactory
				Correctly filled 'Test Record Sheet'
				Correct 'Certificate/PIR' issued (correctly filled)

Random Sample Tests Results (based on test sheets provided)

Pre-Connection:	Continuity of Prot. Conductors: ☐	Max Resistance of Rp+Re : _____ Ω or Re: _____ Ω
	Continuity of Ring Circuits: ☐	Min Insulation Resistance: _____ MΩ Polarity: ☐
Post-Connection:	Earth Loop Impedance: _____ Ω	Associated Protective Device _____ Operation of RCDs/RCBOs @30mA _____ ms

Rule Number	Breaches Found / Comments	10	5	2

Note - Colour coding to be used as a guide only

Major non-conformance | Serious non-conformance | Non-conformance | Total Points

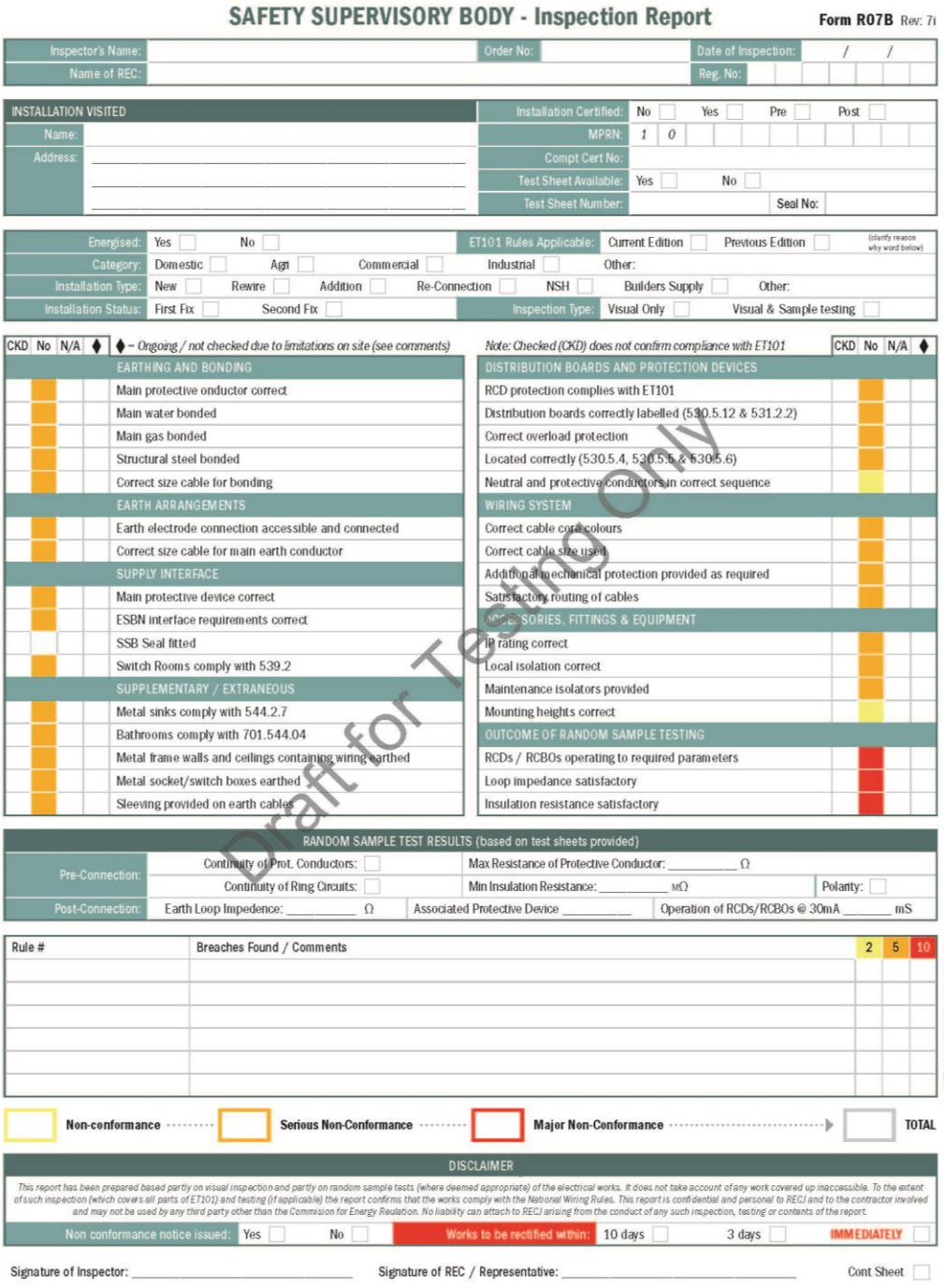
Disclaimer

This report has been prepared based partly on visual inspection and partly on random sample tests (where deemed appropriate) of the electrical works. It does not take account of any work covered up or inaccessible. To the extent of such inspection (which covers all parts of ET101) and testing (if applicable) the report confirms that the works comply with the National Wiring Rules. This report is confidential and personal to Safe Electric and to the contractor involved and may not be used by any third party other than the Commission for Regulation of Utilities (CRU). No liability can attach to Safe Electric arising from the conduct of any such inspection, testing or contents of the report.

Non-Conformance notice issued: Yes ☐ No ☐ | Works to be rectified within: 10 Days ☐ 3 Days ☐ Immediately ☐

Signature of Inspector: _____ Signature of REC / Representative: _____ **Cont Sheet** ☐

Annex Figure 4.B.2. Group 2 (Primacy)



SAFETY SUPERVISORY BODY - Inspection Report

Form R07B Rev: 7i

Inspector's Name: | Order No: | Date of Inspection: / /

Name of REC: | Reg. No:

INSTALLATION VISITED

Name:

Address:

Installation Certified: No Yes Pre Post

MPRN: 1 0

Compt Cert No:

Test Sheet Available: Yes No

Test Sheet Number: | Seal No:

Energised: Yes No

ET101 Rules Applicable: Current Edition Previous Edition (clarify reason why word below)

Category: Domestic Agri Commercial Industrial Other:

Installation Type: New Rewire Addition Re-Connection NSH Builders Supply Other:

Installation Status: First Fix Second Fix

Inspection Type: Visual Only Visual & Sample testing

CKD | No | N/A | ♦ – Ongoing / not checked due to limitations on site (see comments)

Note: Checked (CKD) does not confirm compliance with ET101

CKD	No	N/A		
			EARTHING AND BONDING	
			Main protective onductor correct	
			Main water bonded	
			Main gas bonded	
			Structural steel bonded	
			Correct size cable for bonding	
			EARTH ARRANGEMENTS	
			Earth electrode connection accessible and connected	
			Correct size cable for main earth conductor	
			SUPPLY INTERFACE	
			Main protective device correct	
			ESBN interface requirements correct	
			SSB Seal fitted	
			Switch Rooms comply with 539.2	
			SUPPLEMENTARY / EXTRANEOUS	
			Metal sinks comply with 544.2.7	
			Bathrooms comply with 701.544.04	
			Metal frame walls and ceilings containing wiring earthed	
			Metal socket/switch boxes earthed	
			Sleeving provided on earth cables	

CKD	No	N/A		
			DISTRIBUTION BOARDS AND PROTECTION DEVICES	
			RCD protection complies with ET101	
			Distribution boards correctly labelled (530.5.12 & 531.2.2)	
			Correct overload protection	
			Located correctly (530.5.4, 530.5.5 & 530.5.6)	
			Neutral and protective conductors in correct sequence	
			WIRING SYSTEM	
			Correct cable core colours	
			Correct cable size used	
			Additional mechanical protection provided as required	
			Satisfactory routing of cables	
			ACCESSORIES, FITTINGS & EQUIPMENT	
			IP rating correct	
			Local isolation correct	
			Maintenance isolators provided	
			Mounting heights correct	
			OUTCOME OF RANDOM SAMPLE TESTING	
			RCDs / RCBOs operating to required parameters	
			Loop impedance satisfactory	
			Insulation resistance satisfactory	

Draft for Testing Only

RANDOM SAMPLE TEST RESULTS (based on test sheets provided)

Pre-Connection: Continuity of Prot. Conductors: | Max Resistance of Protective Conductor: _____ Ω

Continuity of Ring Circuits: | Min Insulation Resistance: _____ MΩ | Polarity:

Post-Connection: Earth Loop Impedence: _____ Ω | Associated Protective Device _____ | Operation of RCDs/RCBOs @ 30mA _____ mS

Rule #	Breaches Found / Comments	2	5	10

NOTE: Colour coding to be used as a guide only

Non-conformance ····· Serious Non-Conformance ····· Major Non-Conformance ····· TOTAL

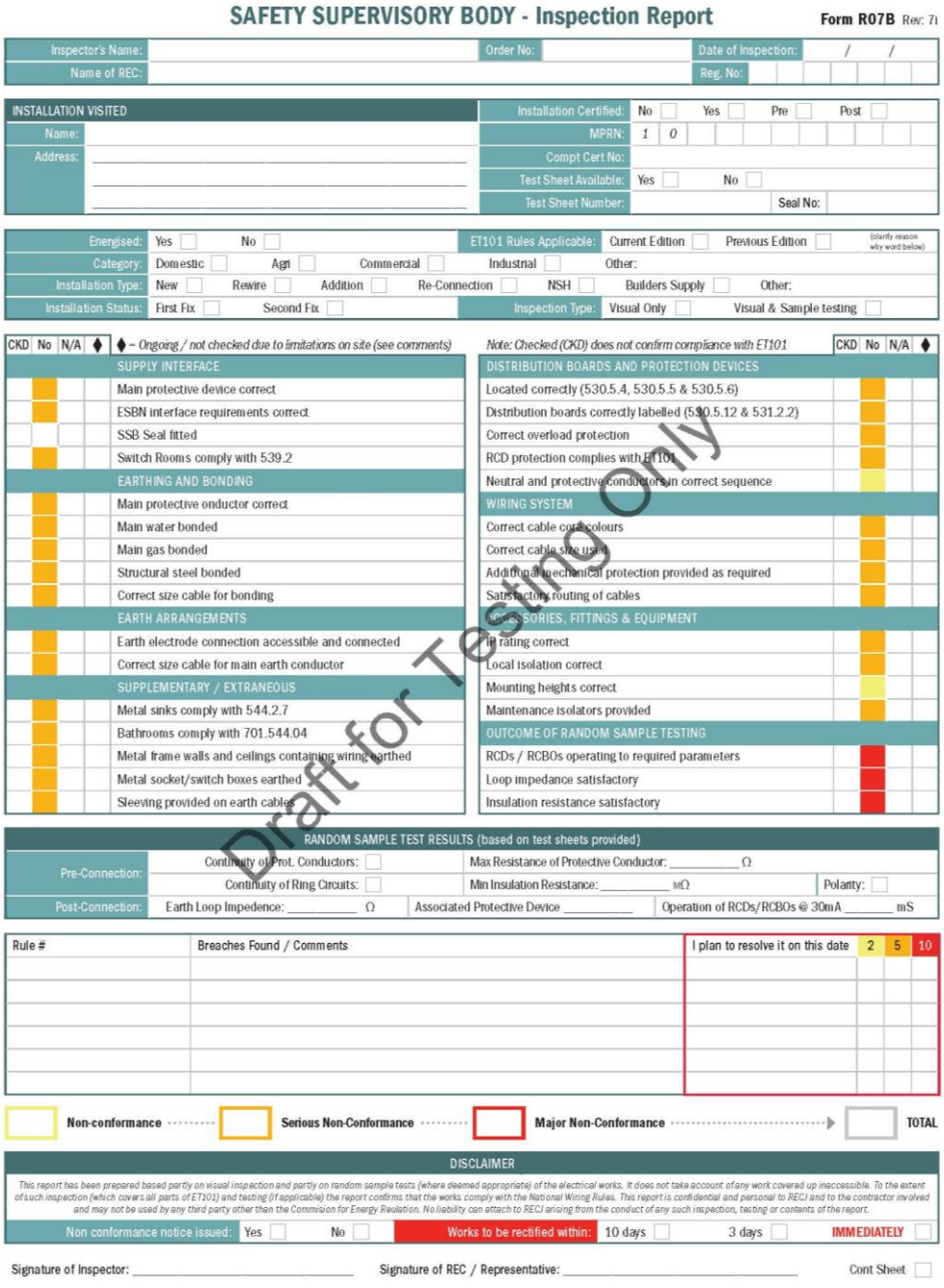
DISCLAIMER

This report has been prepared based partly on visual inspection and partly on random sample tests (where deemed appropriate) of the electrical works. It does not take account of any work covered up inaccessible. To the extent of such inspection (which covers all parts of ET101) and testing (if applicable) the report confirms that the works comply with the National Wiring Rules. This report is confidential and personal to RECI and to the contractor involved and may not be used by any third party other than the Commision for Energy Reulation. No liability can attach to RECI arising from the conduct of any such inspection, testing or contents of the report.

Non conformance notice issued: Yes No | Works to be rectified within: 10 days 3 days IMMEDIATELY

Signature of Inspector: _____ Signature of REC / Representative: _____ Cont Sheet

Annex Figure 4.B.3. Group 3 (Primacy + Implementation Intention)



SAFETY SUPERVISORY BODY - Inspection Report

Form R07B Rev: 7i

Inspector's Name: | Order No: | Date of Inspection: / /

Name of REC: | Reg. No:

INSTALLATION VISITED

Name:

Address:

Installation Certified: No Yes Pre Post

MPRN: 1 0

Compt Cert No:

Test Sheet Available: Yes No

Test Sheet Number: | Seal No:

Energised: Yes No

ET101 Rules Applicable: Current Edition Previous Edition (clarify reason why word below)

Category: Domestic Agri Commercial Industrial Other:

Installation Type: New Rewire Addition Re-Connection NSH Builders Supply Other:

Installation Status: First Fix Second Fix

Inspection Type: Visual Only Visual & Sample testing

CKD | No | N/A | ♦ – Ongoing / not checked due to limitations on site (see comments)

Note: Checked (CKD) does not confirm compliance with ET101

CKD	No	N/A	♦	SUPPLY INTERFACE
				Main protective device correct
				ESBN interface requirements correct
				SSB Seal fitted
				Switch Rooms comply with 539.2
				EARTHING AND BONDING
				Main protective onductor correct
				Main water bonded
				Main gas bonded
				Structural steel bonded
				Correct size cable for bonding
				EARTH ARRANGEMENTS
				Earth electrode connection accessible and connected
				Correct size cable for main earth conductor
				SUPPLEMENTARY / EXTRANEOUS
				Metal sinks comply with 544.2.7
				Bathrooms comply with 701.544.04
				Metal frame walls and ceilings containing wiring earthed
				Metal socket/switch boxes earthed
				Sleeving provided on earth cables

CKD	No	N/A	♦	DISTRIBUTION BOARDS AND PROTECTION DEVICES
				Located correctly (530.5.4, 530.5.5 & 530.5.6)
				Distribution boards correctly labelled (530.5.12 & 531.2.2)
				Correct overload protection
				RCD protection complies with ET101
				Neutral and protective conductors in correct sequence
				WIRING SYSTEM
				Correct cable core colours
				Correct cable size used
				Additional mechanical protection provided as required
				Satisfactory routing of cables
				ACCESSORIES, FITTINGS & EQUIPMENT
				IP rating correct
				Local isolation correct
				Mounting heights correct
				Maintenance isolators provided
				OUTCOME OF RANDOM SAMPLE TESTING
				RCDs / RCBOs operating to required parameters
				Loop impedance satisfactory
				Insulation resistance satisfactory

RANDOM SAMPLE TEST RESULTS (based on test sheets provided)

Pre-Connection: Continuity of Prot. Conductors: Max Resistance of Protective Conductor: _____ Ω

Continuity of Ring Circuits: Min Insulation Resistance: _____ mΩ Polarity:

Post-Connection: Earth Loop Impedence: _____ Ω Associated Protective Device _____ Operation of RCDs/RCBOs @ 30mA _____ mS

Rule #	Breaches Found / Comments	I plan to resolve it on this date	2	5	10

NOTE: Colour coding to be used as a guide only

Non-conformance ····· Serious Non-Conformance ····· Major Non-Conformance ····· TOTAL

DISCLAIMER

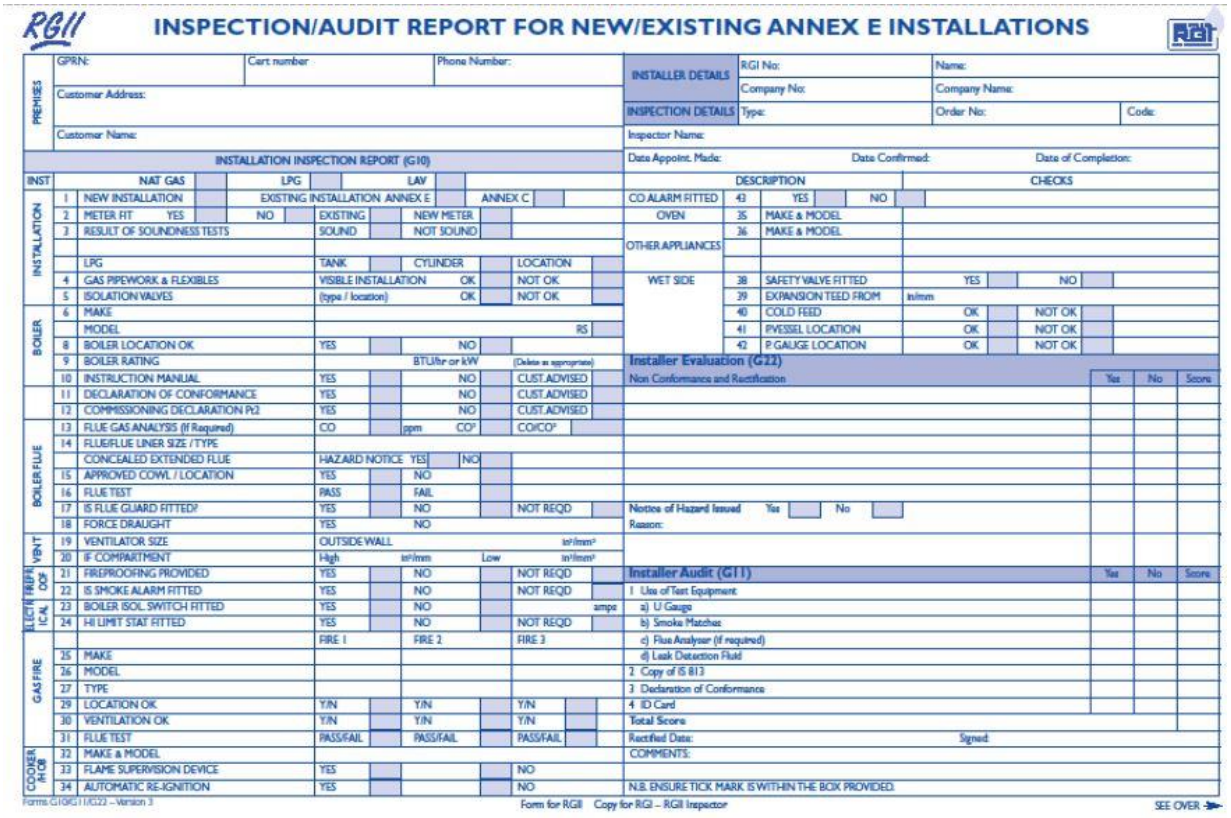
This report has been prepared based partly on visual inspection and partly on random sample tests (where deemed appropriate) of the electrical works. It does not take account of any work covered up inaccessible. To the extent of such inspection (which covers all parts of ET101) and testing (if applicable) the report confirms that the works comply with the National Wiring Rules. This report is confidential and personal to RECI and to the contractor involved and may not be used by any third party other than the Commission for Energy Reulation. No liability can attach to RECI arising from the conduct of any such inspection, testing or contents of the report.

Non conformance notice issued: Yes No Works to be rectified within: 10 days 3 days IMMEDIATELY

Signature of Inspector: _____ Signature of REC / Representative: _____ Cont Sheet

RGI Reports

Annex Figure 4.B.4. Group 1 (Business-as-usual)



RGII **INSPECTION/AUDIT REPORT FOR NEW/EXISTING ANNEX E INSTALLATIONS**

PREMISES
GPRN: | Cert number: | Phone Number:
Customer Address:
Customer Name:

INSTALLER DETAILS: RGI No: | Name: | Company No: | Company Name:
INSPECTION DETAILS: Type: | Order No: | Code:
Inspector Name:
Date Appoint. Made: | Date Confirmed: | Date of Completion:

INSTALLATION INSPECTION REPORT (G10)

INST		NAT GAS		LPG		LAV		
INSTALLATION	1	NEW INSTALLATION		EXISTING INSTALLATION		ANNEX E		ANNEX C
	2	METER FIT YES		NO		EXISTING		NEW METER
	3	RESULT OF SOUNDNESS TESTS				SOUND		NOT SOUND
		LPG				TANK		CYLINDER
	4	GAS PIPEWORK & FLEXIBLES				VISIBLE INSTALLATION	OK	NOT OK
	5	ISOLATION VALVES				(type / location)	OK	NOT OK
BOILER	6	MAKE						
		MODEL						RS
	8	BOILER LOCATION OK				YES		NO
	9	BOILER RATING					BTU/hr or kW	(Delete as appropriate)
	10	INSTRUCTION MANUAL				YES	NO	CUST.ADVISED
	11	DECLARATION OF CONFORMANCE				YES	NO	CUST.ADVISED
	12	COMMISSIONING DECLARATION P12				YES	NO	CUST.ADVISED
BOILER/FLUE	13	FLUE GAS ANALYSIS (If Required)				CO	ppm	CO^2
	14	FLUE/FLUE LINER SIZE / TYPE						
		CONCEALED EXTENDED FLUE				HAZARD NOTICE YES		NO
	15	APPROVED COWL / LOCATION				YES		NO
	16	FLUE TEST				PASS		FAIL
	17	IS FLUE GUARD FITTED?				YES	NO	NOT REQD
	18	FORCE DRAUGHT				YES	NO	
VENT	19	VENTILATOR SIZE				OUTSIDE WALL		in^2/mm^2
	20	IF COMPARTMENT				High	in^2/mm	Low in^2/mm^2
FIRE PROOF	21	FIREPROOFING PROVIDED				YES	NO	NOT REQD
	22	IS SMOKE ALARM FITTED				YES	NO	NOT REQD
ELECTRICAL	23	BOILER ISOL SWITCH FITTED				YES	NO	amps
	24	HI LIMIT STAT FITTED				YES	NO	NOT REQD
						FIRE 1	FIRE 2	FIRE 3
GAS FIRE	25	MAKE						
	26	MODEL						
	27	TYPE						
	29	LOCATION OK				Y/N	Y/N	Y/N
	30	VENTILATION OK				Y/N	Y/N	Y/N
	31	FLUE TEST				PASS/FAIL	PASS/FAIL	PASS/FAIL
COOKER HOB	32	MAKE & MODEL						
	33	FLAME SUPERVISION DEVICE				YES		NO
	34	AUTOMATIC RE-IGNITION				YES		NO

DESCRIPTION			CHECKS			
CO ALARM FITTED	43	YES		NO		
OVEN	35	MAKE & MODEL				
	36	MAKE & MODEL				
OTHER APPLIANCES						
WET SIDE	38	SAFETY VALVE FITTED		YES		NO
	39	EXPANSION TEED FROM	in/mm			
	40	COLD FEED		OK		NOT OK
	41	PVESSEL LOCATION		OK		NOT OK
	42	P GAUGE LOCATION		OK		NOT OK

Installer Evaluation (G22)

Non Conformance and Rectification	Yes	No	Score

Notice of Hazard Issued Yes | No
Reason:

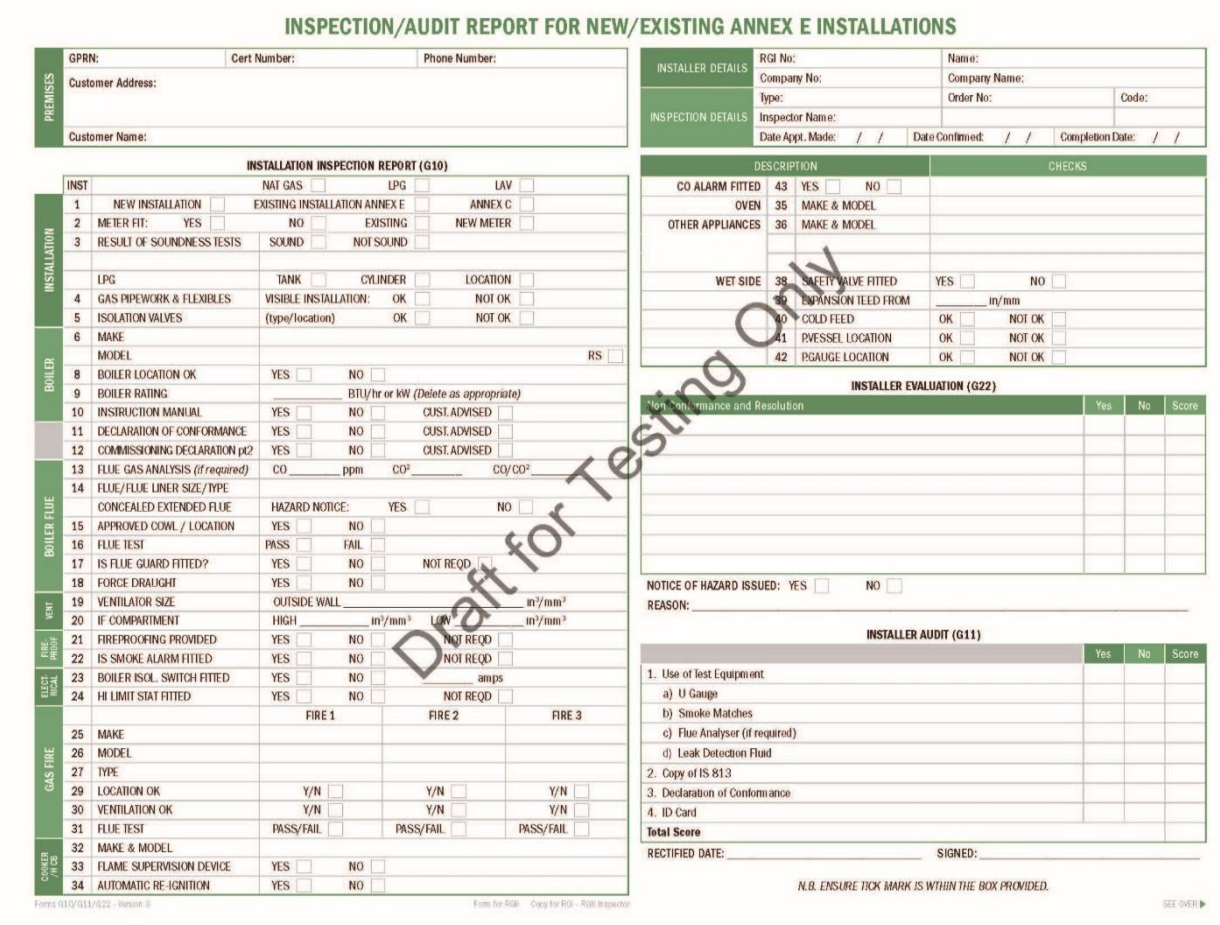
Installer Audit (G11)

	Yes	No	Score
1 Use of Test Equipment			
a) U Gauge			
b) Smoke Matches			
c) Flue Analyser (if required)			
d) Leak Detection Fluid			
2 Copy of IS 813			
3 Declaration of Conformance			
4 ID Card			
Total Score			

Rectified Date: | Signed:
COMMENTS:
N.B. ENSURE TICK MARK IS WITHIN THE BOX PROVIDED.

Forms G10/G11/G22 – Version 3 | Form for RGII | Copy for RGI – RGII Inspector | SEE OVER

Annex Figure 4.B.5. Group 2 (Primacy)



INSPECTION/AUDIT REPORT FOR NEW/EXISTING ANNEX E INSTALLATIONS

PREMISES

GPRN:	Cert Number:	Phone Number:
Customer Address:		
Customer Name:		

INSTALLER DETAILS

RGI No:	Name:	
Company No:	Company Name:	

INSPECTION DETAILS

Type:	Order No:	Code:
Inspector Name:		
Date Appt. Made: / /	Date Confirmed: / /	Completion Date: / /

INSTALLATION INSPECTION REPORT (G10)

	INST				
INSTALLATION	1	NEW INSTALLATION	NAT GAS	LPG	LAV
	2	METER FIT: YES	NO	EXISTING	NEW METER
	3	RESULT OF SOUNDNESS TESTS	SOUND	NOT SOUND	
		LPG	TANK	CYLINDER	LOCATION
	4	GAS PIPEWORK & FLEXIBLES	VISIBLE INSTALLATION:	OK	NOT OK
	5	ISOLATION VALVES	(type/location)	OK	NOT OK
BOILER	6	MAKE			
		MODEL			RS
	8	BOILER LOCATION OK	YES	NO	
	9	BOILER RATING	_____ BTU/hr or kW *(Delete as appropriate)*		
	10	INSTRUCTION MANUAL	YES	NO	CUST. ADVISED
	11	DECLARATION OF CONFORMANCE	YES	NO	CUST. ADVISED
	12	COMMISSIONING DECLARATION pt2	YES	NO	CUST. ADVISED
BOILER FLUE	13	FLUE GAS ANALYSIS *(if required)*	CO _____ ppm	CO^2_____	CO/CO^2_____
	14	FLUE/FLUE LINER SIZE/TYPE			
		CONCEALED EXTENDED FLUE	HAZARD NOTICE:	YES	NO
	15	APPROVED COWL / LOCATION	YES	NO	
	16	FLUE TEST	PASS	FAIL	
	17	IS FLUE GUARD FITTED?	YES	NO	NOT REQD
	18	FORCE DRAUGHT	YES	NO	
VENT	19	VENTILATOR SIZE	OUTSIDE WALL _____		in^2/mm^2
	20	IF COMPARTMENT	HIGH _____ in^2/mm^2	LOW _____	in^2/mm^2
FIRE PROOF	21	FIREPROOFING PROVIDED	YES	NO	NOT REQD
	22	IS SMOKE ALARM FITTED	YES	NO	NOT REQD
ELECT ISOL	23	BOILER ISOL. SWITCH FITTED	YES	NO	_____ amps
	24	HI LIMIT STAT FITTED	YES	NO	NOT REQD
			FIRE 1	FIRE 2	FIRE 3
GAS FIRE	25	MAKE			
	26	MODEL			
	27	TYPE			
	29	LOCATION OK	Y/N	Y/N	Y/N
	30	VENTILATION OK	Y/N	Y/N	Y/N
	31	FLUE TEST	PASS/FAIL	PASS/FAIL	PASS/FAIL
COOKER / HOB	32	MAKE & MODEL			
	33	FLAME SUPERVISION DEVICE	YES	NO	
	34	AUTOMATIC RE-IGNITION	YES	NO	

DESCRIPTION			CHECKS
CO ALARM FITTED	43	YES NO	
OVEN	35	MAKE & MODEL	
OTHER APPLIANCES	36	MAKE & MODEL	
WET SIDE	38	SAFETY VALVE FITTED	YES NO
	39	EXPANSION TEED FROM	_____ in/mm
	40	COLD FEED	OK NOT OK
	41	P.VESSEL LOCATION	OK NOT OK
	42	P.GAUGE LOCATION	OK NOT OK

INSTALLER EVALUATION (G22)

Non Conformance and Resolution	Yes	No	Score

NOTICE OF HAZARD ISSUED: YES NO

REASON: _____

INSTALLER AUDIT (G11)

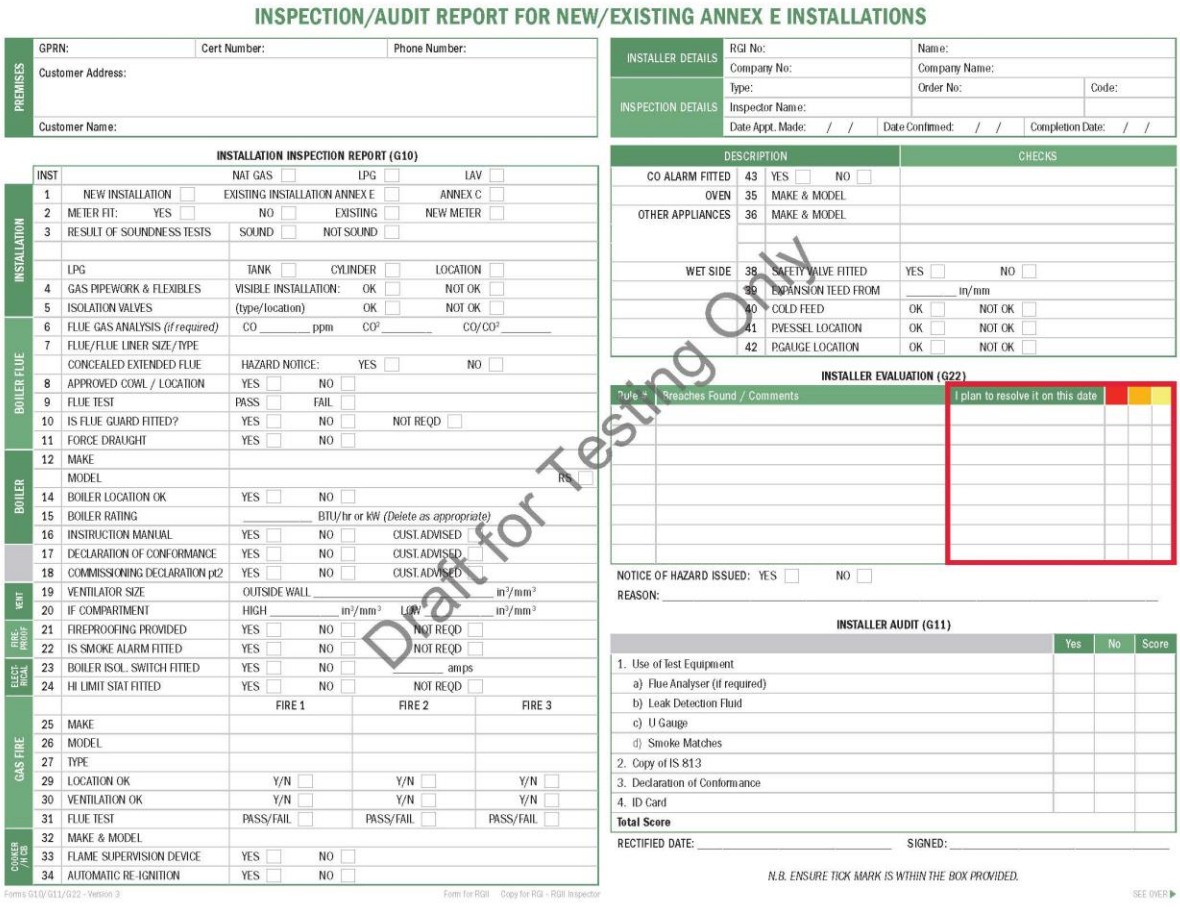
	Yes	No	Score
1. Use of Test Equipment			
a) U Gauge			
b) Smoke Matches			
c) Flue Analyser (if required)			
d) Leak Detection Fluid			
2. Copy of IS 813			
3. Declaration of Conformance			
4. ID Card			
Total Score			

RECTIFIED DATE: _____ SIGNED: _____

N.B. ENSURE TICK MARK IS WITHIN THE BOX PROVIDED.

Draft for Testing Only

Annex Figure 4.B.6. Group 3 (Primacy + Implementation Intention)



INSPECTION/AUDIT REPORT FOR NEW/EXISTING ANNEX E INSTALLATIONS

PREMISES: GPRN: | Cert Number: | Phone Number: | Customer Address: | Customer Name:

INSTALLER DETAILS: RGI No: | Name: | Company No: | Company Name:

INSPECTION DETAILS: Type: | Order No: | Code: | Inspector Name: | Date Appt. Made: / / | Date Confirmed: / / | Completion Date: / /

INSTALLATION INSPECTION REPORT (G10)

	INST					
INSTALLATION			NAT GAS ☐	LPG ☐	LAV ☐	
	1	NEW INSTALLATION ☐	EXISTING INSTALLATION ANNEX E ☐		ANNEX C ☐	
	2	METER FIT: YES ☐	NO ☐	EXISTING ☐	NEW METER ☐	
	3	RESULT OF SOUNDNESS TESTS	SOUND ☐	NOT SOUND ☐		
		LPG	TANK ☐	CYLINDER ☐	LOCATION ☐	
	4	GAS PIPEWORK & FLEXIBLES	VISIBLE INSTALLATION:	OK ☐	NOT OK ☐	
	5	ISOLATION VALVES	(type/location)	OK ☐	NOT OK ☐	
BOILER FLUE	6	FLUE GAS ANALYSIS *(if required)*	CO _____ ppm	CO^2 _____	CO/CO^2 _____	
	7	FLUE/FLUE LINER SIZE/TYPE				
		CONCEALED EXTENDED FLUE	HAZARD NOTICE:	YES ☐	NO ☐	
	8	APPROVED COWL / LOCATION	YES ☐	NO ☐		
	9	FLUE TEST	PASS ☐	FAIL ☐		
	10	IS FLUE GUARD FITTED?	YES ☐	NO ☐	NOT REQD ☐	
	11	FORCE DRAUGHT	YES ☐	NO ☐		
BOILER	12	MAKE				
		MODEL			RS ☐	
	14	BOILER LOCATION OK	YES ☐	NO ☐		
	15	BOILER RATING	_____ BTU/hr or kW *(Delete as appropriate)*			
	16	INSTRUCTION MANUAL	YES ☐	NO ☐	CUST. ADVISED ☐	
	17	DECLARATION OF CONFORMANCE	YES ☐	NO ☐	CUST. ADVISED ☐	
	18	COMMISSIONING DECLARATION pt2	YES ☐	NO ☐	CUST. ADVISED ☐	
VENT	19	VENTILATOR SIZE	OUTSIDE WALL _____			in^2/mm^2
	20	IF COMPARTMENT	HIGH _____ in^2/mm^2	LOW _____		in^2/mm^2
FIRE PROOF	21	FIREPROOFING PROVIDED	YES ☐	NO ☐	NOT REQD ☐	
	22	IS SMOKE ALARM FITTED	YES ☐	NO ☐	NOT REQD ☐	
ELECT. ISOL.	23	BOILER ISOL. SWITCH FITTED	YES ☐	NO ☐	_____ amps	
	24	HI LIMIT STAT FITTED	YES ☐	NO ☐	NOT REQD ☐	
GAS FIRE			FIRE 1	FIRE 2	FIRE 3	
	25	MAKE				
	26	MODEL				
	27	TYPE				
	29	LOCATION OK	Y/N ☐	Y/N ☐	Y/N ☐	
	30	VENTILATION OK	Y/N ☐	Y/N ☐	Y/N ☐	
	31	FLUE TEST	PASS/FAIL ☐	PASS/FAIL ☐	PASS/FAIL ☐	
COOKER / HOB	32	MAKE & MODEL				
	33	FLAME SUPERVISION DEVICE	YES ☐	NO ☐		
	34	AUTOMATIC RE-IGNITION	YES ☐	NO ☐		

DESCRIPTION		CHECKS
CO ALARM FITTED	43	YES ☐ NO ☐
OVEN	35	MAKE & MODEL
OTHER APPLIANCES	36	MAKE & MODEL
WET SIDE	38	SAFETY VALVE FITTED: YES ☐ NO ☐
	39	EXPANSION TEED FROM _____ in/mm
	40	COLD FEED: OK ☐ NOT OK ☐
	41	P.VESSEL LOCATION: OK ☐ NOT OK ☐
	42	P.GAUGE LOCATION: OK ☐ NOT OK ☐

INSTALLER EVALUATION (G22)

Rule #	Breaches Found / Comments	I plan to resolve it on this date

NOTICE OF HAZARD ISSUED: YES ☐ NO ☐

REASON: _____

INSTALLER AUDIT (G11)

	Yes	No	Score
1. Use of Test Equipment			
a) Flue Analyser (if required)			
b) Leak Detection Fluid			
c) U Gauge			
d) Smoke Matches			
2. Copy of IS 813			
3. Declaration of Conformance			
4. ID Card			
Total Score			

RECTIFIED DATE: _____ SIGNED: _____

N.B. ENSURE TICK MARK IS WITHIN THE BOX PROVIDED.

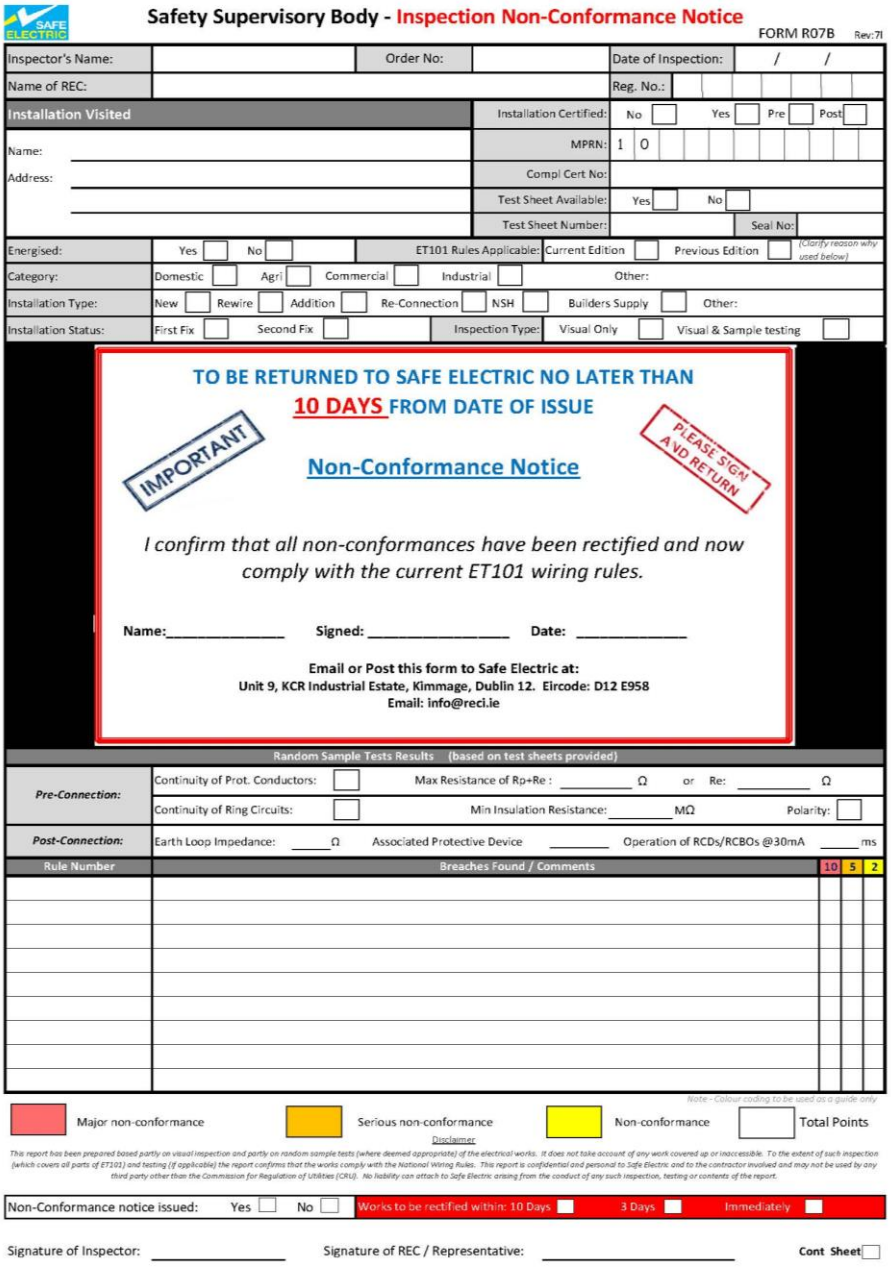
SEE OVER ▶

Forms G10/G11/G22 - Version 3 | Form for RGII | Copy for RGI - RGII Inspector

Draft for Testing Only

REC Notices

Annex Figure 4.B.7. Group 1 (Business-as-Usual)



Safety Supervisory Body - Inspection Non-Conformance Notice

FORM R07B Rev:7I

Inspector's Name:		Order No:		Date of Inspection:	/ /
Name of REC:				Reg. No.:	
Installation Visited			Installation Certified:	No ☐ Yes ☐ Pre ☐ Post ☐	
Name:			MPRN:	1 0	
Address:			Compl Cert No:		
			Test Sheet Available:	Yes ☐ No ☐	
			Test Sheet Number:	Seal No:	
Energised:	Yes ☐ No ☐		ET101 Rules Applicable:	Current Edition ☐ Previous Edition ☐	(Clarify reason why used below)
Category:	Domestic ☐ Agri ☐ Commercial ☐ Industrial ☐		Other:		
Installation Type:	New ☐ Rewire ☐ Addition ☐ Re-Connection ☐ NSH ☐ Builders Supply ☐ Other:				
Installation Status:	First Fix ☐ Second Fix ☐		Inspection Type:	Visual Only ☐ Visual & Sample testing ☐	

TO BE RETURNED TO SAFE ELECTRIC NO LATER THAN
10 DAYS FROM DATE OF ISSUE

IMPORTANT

PLEASE SIGN AND RETURN

Non-Conformance Notice

I confirm that all non-conformances have been rectified and now comply with the current ET101 wiring rules.

Name:_____ Signed: _____ Date: _____

Email or Post this form to Safe Electric at:
Unit 9, KCR Industrial Estate, Kimmage, Dublin 12. Eircode: D12 E958
Email: info@reci.ie

Random Sample Tests Results (based on test sheets provided)

Pre-Connection:	Continuity of Prot. Conductors: ☐	Max Resistance of Rp+Re : _____ Ω	or Re: _____ Ω	
	Continuity of Ring Circuits: ☐	Min Insulation Resistance: _____ MΩ	Polarity: ☐	
Post-Connection:	Earth Loop Impedance: _____ Ω	Associated Protective Device _____	Operation of RCDs/RCBOs @30mA _____ ms	

Rule Number	Breaches Found / Comments	10	5	2

Note - Colour coding to be used as a guide only

Major non-conformance | Serious non-conformance | Non-conformance | Total Points

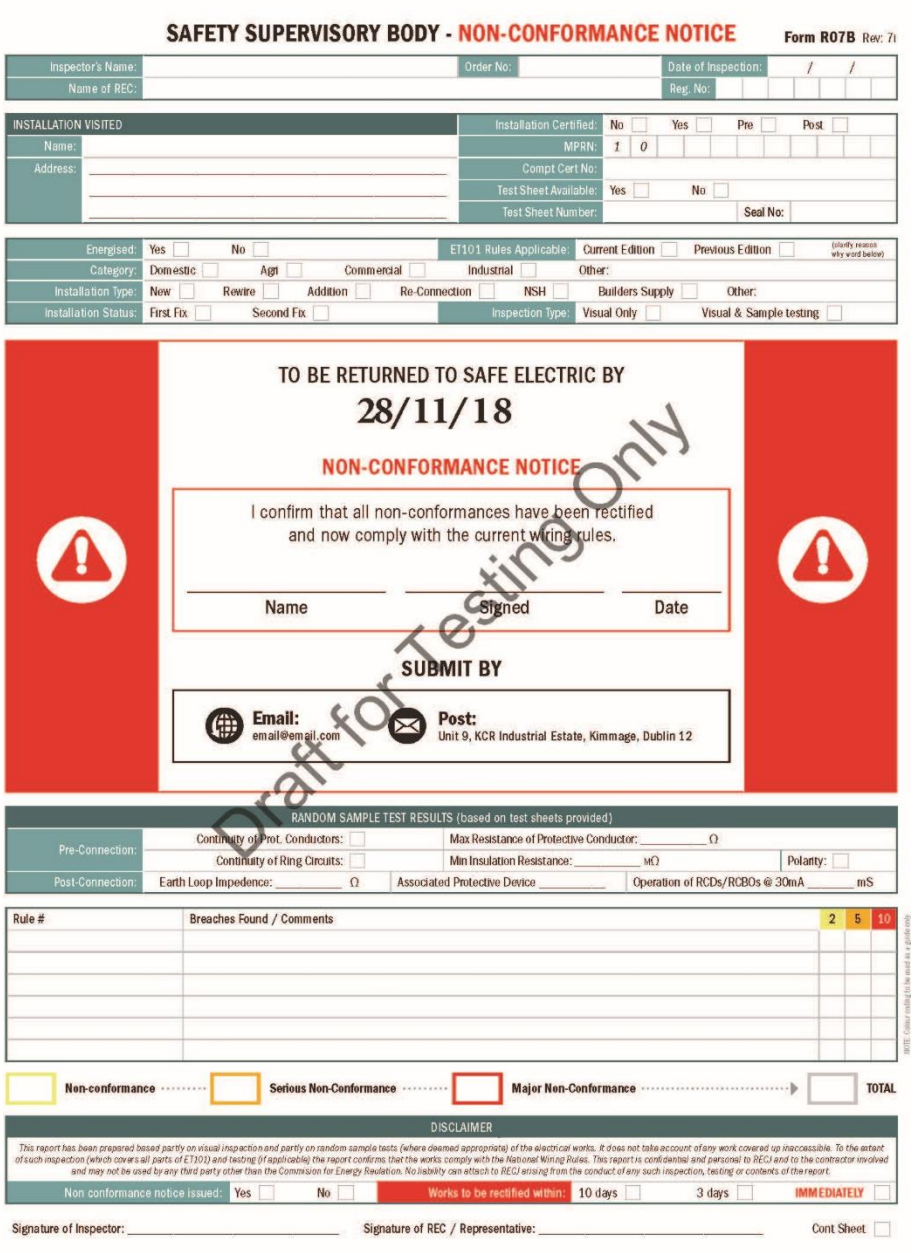
Disclaimer

This report has been prepared based partly on visual inspection and partly on random sample tests (where deemed appropriate) of the electrical works. It does not take account of any work covered up or inaccessible. To the extent of such inspection (which covers all parts of ET101) and testing (if applicable) the report confirms that the works comply with the National Wiring Rules. This report is confidential and personal to Safe Electric and to the contractor involved and may not be used by any third party other than the Commission for Regulation of Utilities (CRU). No liability can attach to Safe Electric arising from the conduct of any such inspection, testing or contents of the report.

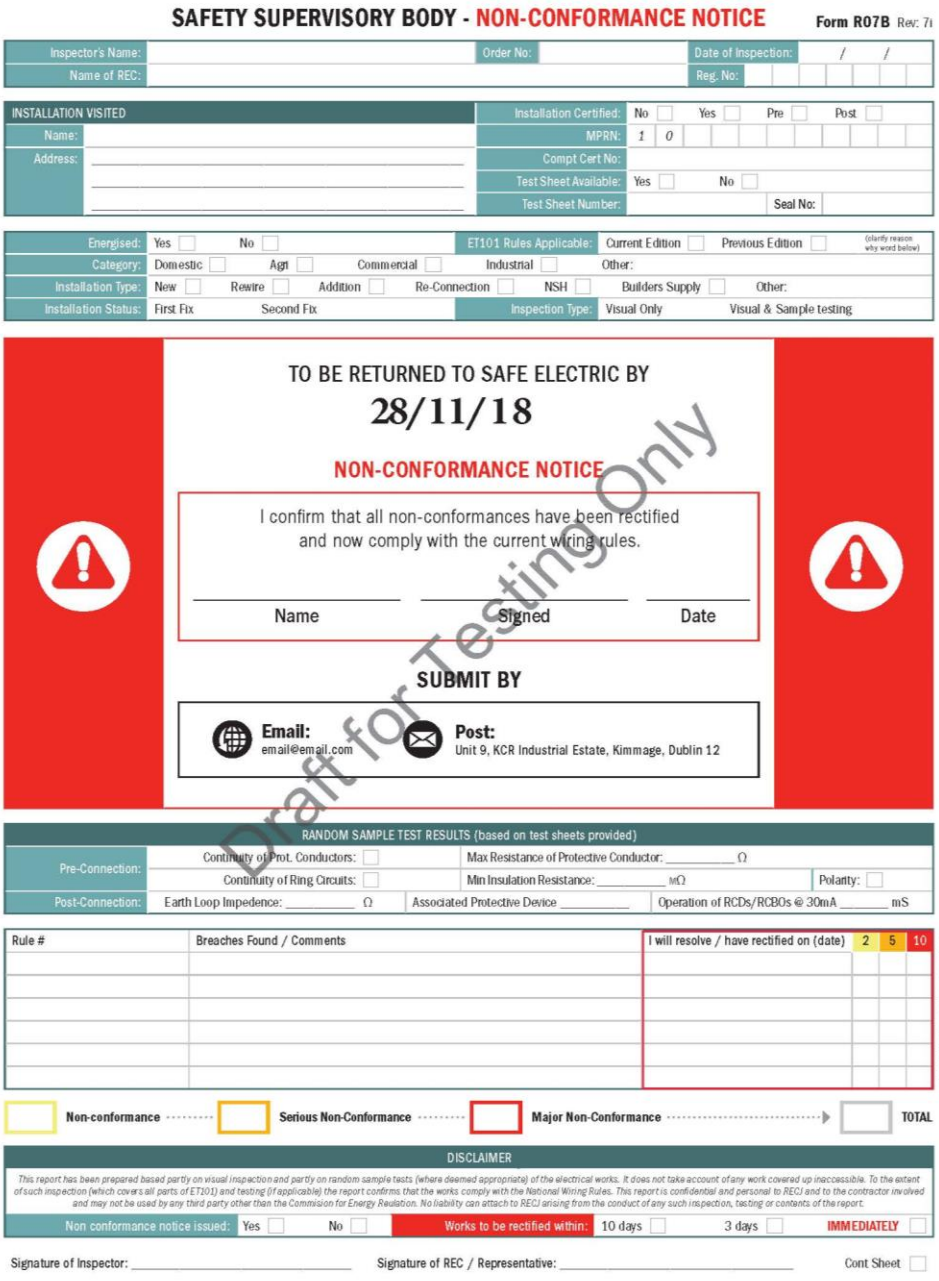
Non-Conformance notice issued: Yes ☐ No ☐ Works to be rectified within: 10 Days ☐ 3 Days ☐ Immediately ☐

Signature of Inspector: _____ Signature of REC / Representative: _____ Cont Sheet ☐

Annex Figure 4.B.8. Group 2 (Personalisation)



Annex Figure 4.B.9. Group 3 (Personalisation + Implementation Intention)



SAFETY SUPERVISORY BODY - NON-CONFORMANCE NOTICE

Form R07B Rev: 7i

Inspector's Name: | Order No: | Date of Inspection: / /

Name of REC: | Reg. No:

INSTALLATION VISITED

Name:

Address:

Installation Certified: No Yes Pre Post

MPRN: 1 0

Compt Cert No:

Test Sheet Available: Yes No

Test Sheet Number: Seal No:

Energised: Yes No

ET101 Rules Applicable: Current Edition Previous Edition (clarify reason why word below)

Category: Domestic Agri Commercial Industrial Other:

Installation Type: New Rewire Addition Re-Connection NSH Builders Supply Other:

Installation Status: First Fix Second Fix

Inspection Type: Visual Only Visual & Sample testing

TO BE RETURNED TO SAFE ELECTRIC BY

28/11/18

NON-CONFORMANCE NOTICE

I confirm that all non-conformances have been rectified and now comply with the current wiring rules.

Name Signed Date

SUBMIT BY

Email: email@email.com

Post: Unit 9, KCR Industrial Estate, Kimmage, Dublin 12

Draft for Testing Only

RANDOM SAMPLE TEST RESULTS (based on test sheets provided)

Pre-Connection: Continuity of Prot. Conductors: Max Resistance of Protective Conductor: _____ Ω

Continuity of Ring Circuits: Min Insulation Resistance: _____ MΩ Polarity:

Post-Connection: Earth Loop Impedence: _____ Ω Associated Protective Device _____ Operation of RCDs/RCBOs @ 30mA _____ mS

Rule #	Breaches Found / Comments	I will resolve / have rectified on (date) 2 5 10

Non-conformance Serious Non-Conformance Major Non-Conformance TOTAL

DISCLAIMER

This report has been prepared based partly on visual inspection and partly on random sample tests (where deemed appropriate) of the electrical works. It does not take account of any work covered up inaccessible. To the extent of such inspection (which covers all parts of ET101) and testing (if applicable) the report confirms that the works comply with the National Wiring Rules. This report is confidential and personal to RECI and to the contractor involved and may not be used by any third party other than the Commission for Energy Regulation. No liability can attach to RECI arising from the conduct of any such inspection, testing or contents of the report.

Non conformance notice issued: Yes No Works to be rectified within: 10 days 3 days IMMEDIATELY

Signature of Inspector: _____ Signature of REC / Representative: _____ Cont Sheet

RGI Notices

Annex Figure 4.B.10. Group 1 (Business-as-Usual)

Dear Registered Gas Installer

The attached copy of the Inspection and Audit form is your indication that The Register of Gas Installers of Ireland have carried out an Inspection/Audit, for compliance with the Irish Standard for Domestic Gas Installations (I.S.813) at the address indicated on this form.

The defects found are listed and coded on the Installer Evaluation (G22) part of this form. You must rectify these defects within twenty-four hours for Code Red Defects (R), three working days for Code Orange (O) and twenty-one working days for Code Lemon Defects (L) as per the rules (16:1) of registration. These defects are held on file against your registration number.

After rectifying the defects listed, you must tick the "yes" box in the Installer Evaluation (G22) part of the form and sign and date it as a confirmation that all defects have been rectified. This form is then to be returned to RGII. Please note that this installation may be selected for a re-inspection.

Failure to comply with this requirement may lead to disciplinary action in accordance with section D of the criteria document and the rules of registration (16:2).

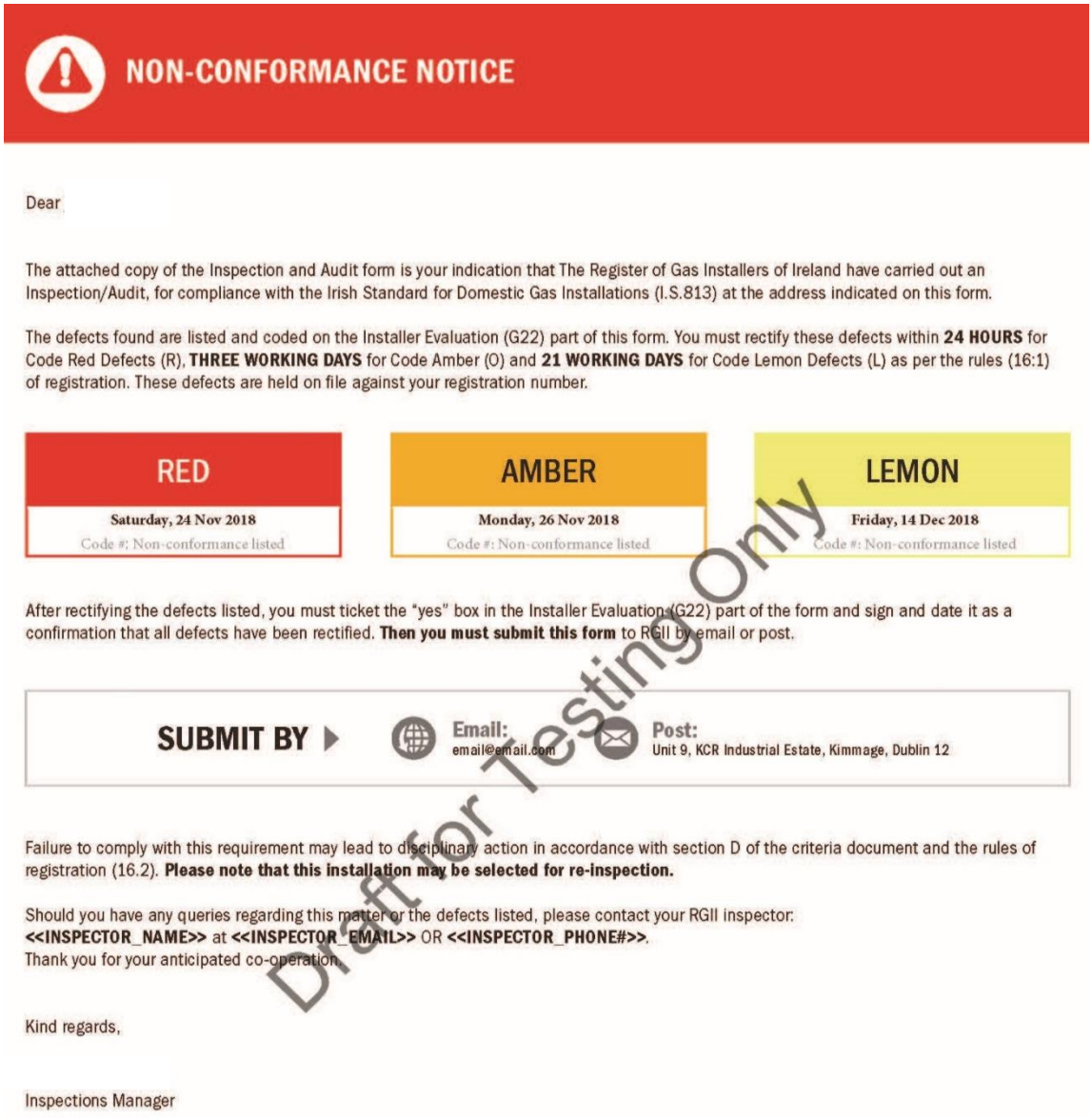
Should you have any queries regarding this matter or the defects listed, please contact your RGII inspector.

Thank you for your anticipated co-operation.

Kind Regards

Inspections Manager
Register of Gas Installers of Ireland

Annex Figure 4.B.11. Group 2 (Personalisation)



NON-CONFORMANCE NOTICE

Dear

The attached copy of the Inspection and Audit form is your indication that The Register of Gas Installers of Ireland have carried out an Inspection/Audit, for compliance with the Irish Standard for Domestic Gas Installations (I.S.813) at the address indicated on this form.

The defects found are listed and coded on the Installer Evaluation (G22) part of this form. You must rectify these defects within **24 HOURS** for Code Red Defects (R), **THREE WORKING DAYS** for Code Amber (O) and **21 WORKING DAYS** for Code Lemon Defects (L) as per the rules (16:1) of registration. These defects are held on file against your registration number.

RED	AMBER	LEMON
Saturday, 24 Nov 2018	Monday, 26 Nov 2018	Friday, 14 Dec 2018
Code #: Non-conformance listed	Code #: Non-conformance listed	Code #: Non-conformance listed

After rectifying the defects listed, you must ticket the "yes" box in the Installer Evaluation (G22) part of the form and sign and date it as a confirmation that all defects have been rectified. **Then you must submit this form** to RGII by email or post.

SUBMIT BY ▸ Email: email@email.com Post: Unit 9, KCR Industrial Estate, Kimmage, Dublin 12

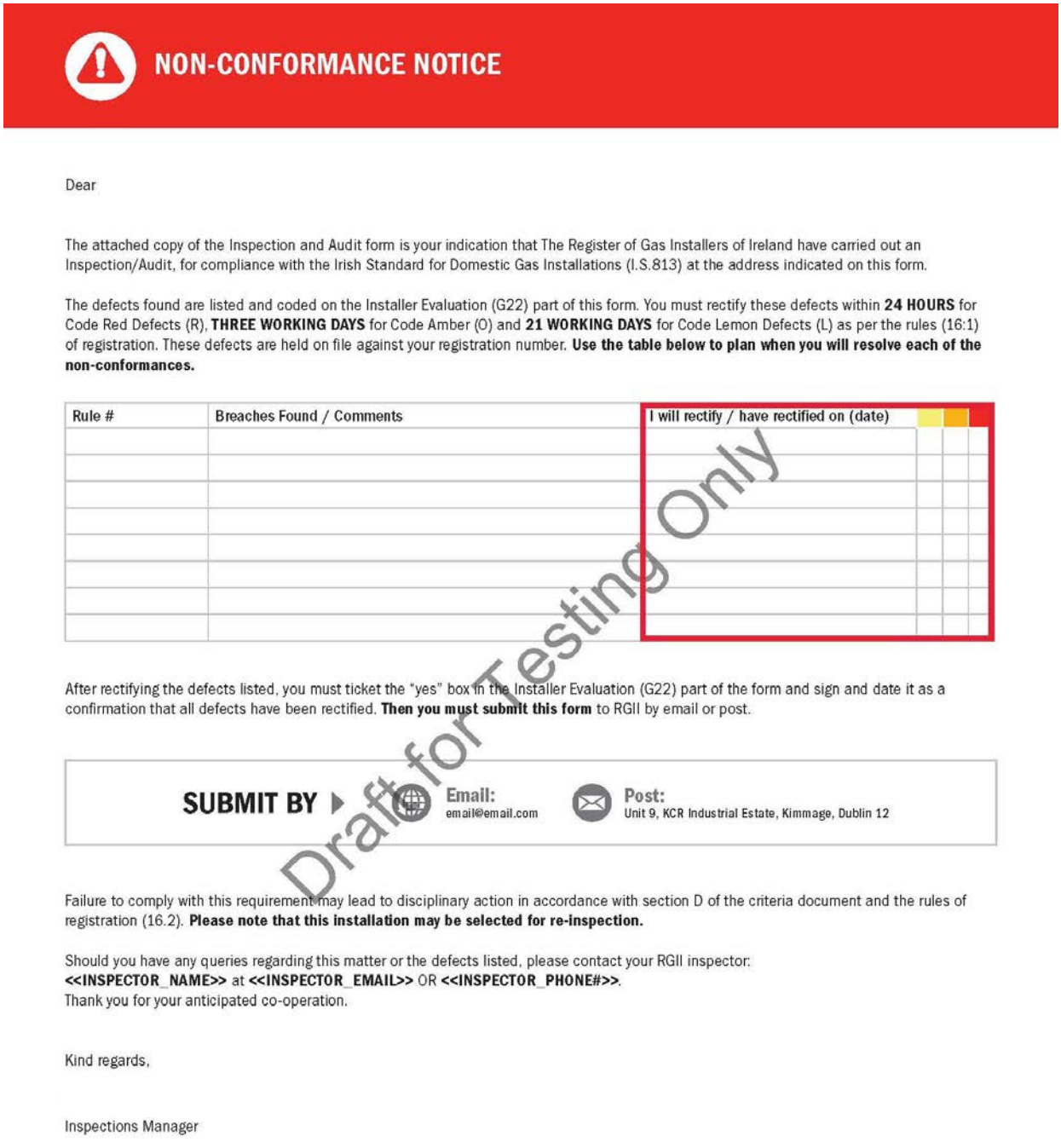
Failure to comply with this requirement may lead to disciplinary action in accordance with section D of the criteria document and the rules of registration (16.2). **Please note that this installation may be selected for re-inspection.**

Should you have any queries regarding this matter or the defects listed, please contact your RGII inspector: **<<INSPECTOR_NAME>>** at **<<INSPECTOR_EMAIL>>** OR **<<INSPECTOR_PHONE#>>**.
Thank you for your anticipated co-operation.

Kind regards,

Inspections Manager

Annex Figure 4.B.12. Group 3 (Personalisation + implementation intention)



NON-CONFORMANCE NOTICE

Dear

The attached copy of the Inspection and Audit form is your indication that The Register of Gas Installers of Ireland have carried out an Inspection/Audit, for compliance with the Irish Standard for Domestic Gas Installations (I.S.813) at the address indicated on this form.

The defects found are listed and coded on the Installer Evaluation (G22) part of this form. You must rectify these defects within **24 HOURS** for Code Red Defects (R), **THREE WORKING DAYS** for Code Amber (O) and **21 WORKING DAYS** for Code Lemon Defects (L) as per the rules (16:1) of registration. These defects are held on file against your registration number. **Use the table below to plan when you will resolve each of the non-conformances.**

Rule #	Breaches Found / Comments	I will rectify / have rectified on (date)

After rectifying the defects listed, you must ticket the "yes" box in the Installer Evaluation (G22) part of the form and sign and date it as a confirmation that all defects have been rectified. **Then you must submit this form** to RGII by email or post.

SUBMIT BY Email: email@email.com Post: Unit 9, KCR Industrial Estate, Kimmage, Dublin 12

Draft for Testing Only

Failure to comply with this requirement may lead to disciplinary action in accordance with section D of the criteria document and the rules of registration (16.2). **Please note that this installation may be selected for re-inspection.**

Should you have any queries regarding this matter or the defects listed, please contact your RGII inspector: **<<INSPECTOR_NAME>>** at **<<INSPECTOR_EMAIL>>** OR **<<INSPECTOR_PHONE#>>**.
Thank you for your anticipated co-operation.

Kind regards,

Inspections Manager

5 Case studies: How regulators in Ireland, Mexico, and Oman currently address safety culture and behavioural biases

This chapter presents case studies from Ireland, Mexico and Oman that were prepared as part of the scoping work presented in Chapter 4. These seek to help understand more clearly the country's regulatory context and identify some of the behavioural barriers present to inform the future experimental design.

Culture influences the decisions and behaviours of people in an organisation, and these behaviours ultimately drive safety outcomes and performance. Creating a safety culture entails changing the organisation's norms, practices, competencies leading to a sustainable change in attitudes and behaviours towards safety. While there is a clear recognition that changing attitudes and behaviours towards safety is essential to avoid high consequence incidents, 'how to do it' poses a number of challenges, including biases, gaps and blind spots that originate in individuals' cognitive capacities and then permeates the practices and decision-processes of organisations.

This chapter presents a series of case studies on the role, approach and issues in fostering a safety culture faced by:[1]

- Ireland's Commission for Regulation of Utilities: electrical contractors, gas installers, gas supply, shipping, transportation and storage and upstream petroleum extraction and exploration activities;
- Mexico's Agency for Safety, Energy and Environment: hydrocarbon sector (from upstream to downstream)
- Oman's Authority for Electricity Regulation: electricity

The case studies were prepared as part of the scoping work presented in Chapter 3, and built on public sources and information provided by the five agencies. They identified key behavioural barriers to creating a safety culture and served as a basis to start designing experiments around behavioural barriers and solutions to safety culture.

This chapter first presents an overview of the key behavioural barriers identified, and then presents the each country's case study. This chapter and Chapter 3 then combined to form the basis for the safety culture experiments conducted and presented in Chapter 4.

Key behavioural barriers identified through the case studies

The case studies highlighted a common recognition of the importance of creating a safety culture to ensure compliance and minimise the risk of accidents. They also stressed the challenges in fostering a safety culture through the methods and approaches of the regulator and the regulated entities.

The case studies suggest the importance of the approach to safety from the regulator to the regulated entities, including through the way in which the regulator oversees and communicates on safety with the regulated business and operators (inside the regulator). Key barriers to foster a safety oversight culture emerging from the case studies include:

- ***Framing***: deeper understanding of the importance of safety can be undermined by inconsistency/contradictions in messaging.
- ***Saliency***: the diversity of regulators involved in safety added to a focus on compliance with procedures rather than results can reduce effectiveness and saliency of communication;
- ***Overseeing/indicators***: a challenge is to identify indicators that promote reporting of risks and possible hazards and track the emergence of a culture among leadership and staff. Heavy reliance on occurrence data models or subsectors with under-developed data collection systems can create blind spots.

Ultimately, however, the emergence of a safety culture depends on the extent to which safety is embraced as a key feature of the organisational culture of regulated entities (outside the regulator). The case studies stress a number of challenges and behavioural barriers in creating such an organisational culture:

- ***Leadership commitment*****:** it is recognised as crucial in fostering a cultural change in organisations. Production pressures, poor internal communication and (false) perception that safety is just an extra cost all undermine safety leadership.

- ***Complacency***: this can be significant when an operator has faced no major incident for a number of years. It can be linked to a (misleading) belief that this is the result of robust systems or of the use of new or established technologies that, because their use is widespread, must ensure safety.
- ***Information bias***: staff can underestimate how certain actions or failure to take action can impact safety.
- ***Lack of clarity on roles and responsibilities for safety performance*:** this can include little attention for who is authorised to operate or test certain activities, or who has the authority to issue or cancel such permissions.

Ireland's Commission for Regulation of Utilities

This section provides an overview of the role, approach and issues faced by the Commission for Regulation of Utilities (CRU) in fostering a safety culture in the sectors it oversees. The purpose is to identify key behavioural barriers to creating a safety culture and methods and approaches identified by regulators to tackle these barriers. This section draws on information provided by CRU as well as Driving Performance at Ireland's Commission for Regulation of Utilities (OECD, 2018[1]).

Overall role and institutional set-up

The CRU is an independent multi-sector regulator with economic, customer and safety functions and duties in Ireland's energy and water sectors. It was initially established as the Commission for Electricity Regulation (CER) by the Electricity Regulation Act, 1999; however, as its mandate increased, the Commission updated its name to become the Commission for Energy Regulation (CRU) in 2017. The CRU's mission is "*Protecting the public interest in water, energy and energy safety*".

The CRU operates in the framework of a Strategic Plan (2019-2021) that sets the following strategic priorities (CRU, 2019[2]):

- Deliver sustainable, low-carbon solutions with well-regulated markets and networks
- Ensure compliance and accountability through best regulatory practice
- Develop effective communications to support customers and the regulatory process
- Foster and maintain a high-performance culture and organisation to achieve our vision.

The CRU falls under the aegis of two line Ministries, the Department of Communications, Climate Action and Environment (DCCAE) and the Department of Housing, Planning and Local Government (DHPLG). Commissioners are appointed by the Minister. The Chair of the Commission is selected by the Minister from the serving Commissioners on a rotating basis for a period of typically two to three years, but there is no prescribed term for this (OECD, 2018[1]) .

Safety responsibilities

The primary focus of the CRU's safety responsibilities is the protection of the public in three sectors: i) upstream petroleum activities; ii) natural gas and liquid petroleum gas (LPG) undertakings; iii) gas installers (CER, 2016[3]) and electrical contractors (CER, 2016[4]) carrying out domestic gas and electrical works.

Key functions include:

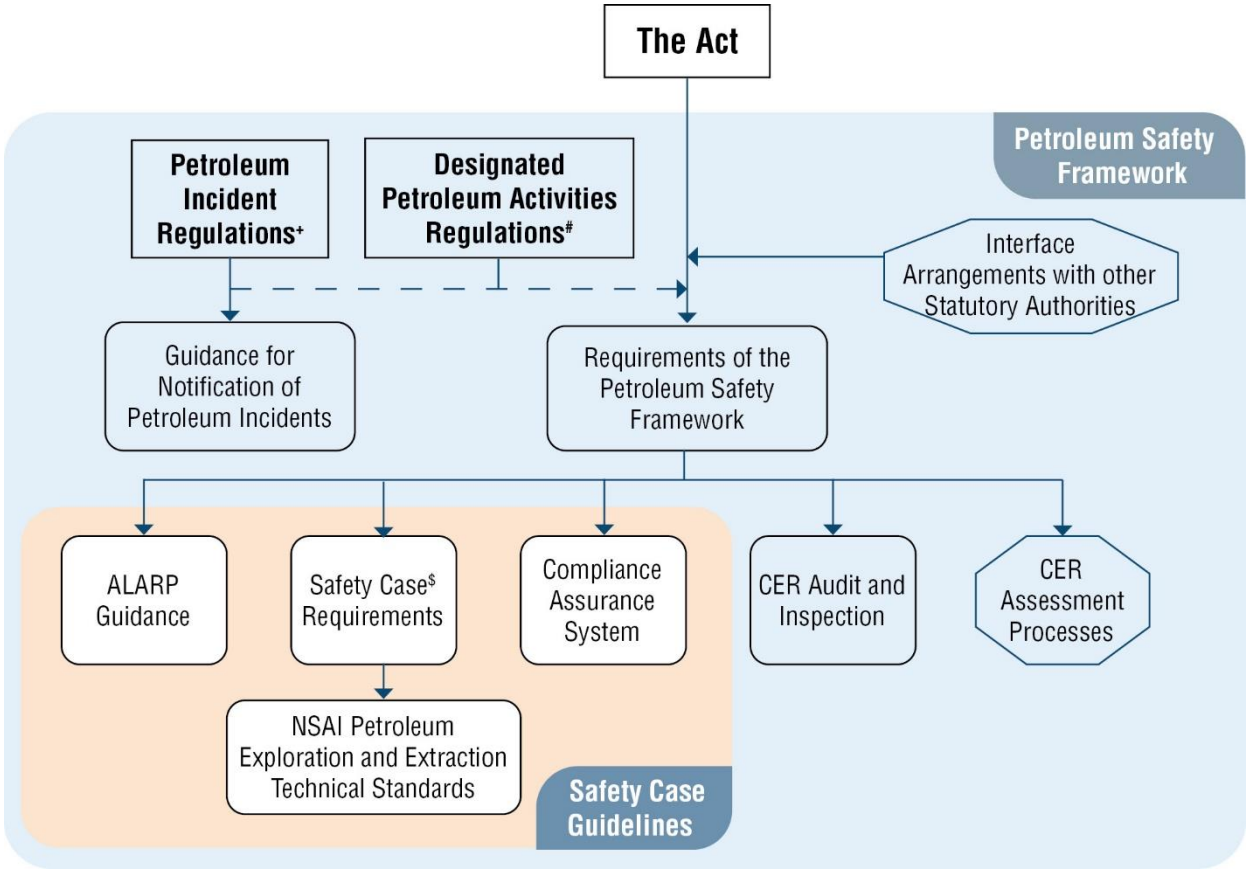
- Regulating gas network safety including gas shipping/supply, storage, transmission and distribution;

- Regulating petroleum (oil and gas) safety, including exploration, extraction and decommissioning (onshore and offshore);
- Designing and overseeing safety supervisory schemes for electrical contractors and gas installers;
- Setting programmes of audit and inspection of regulated entities;
- Issuing safety permits for petroleum activities and safety licences to LPG undertakings;
- Promoting and raising public awareness of electrical and gas safety issues.

Upstream petroleum activities

CRU has been responsible for the safety of both onshore and offshore petroleum activities focusing on major accident hazards within a Petroleum Safety Framework (CER, 2017[5]); (CER, 2017[6])set up under the Petroleum Safety Acts since December 2013 (Figure 5.1).[2]

Figure 5.1. Ireland's Petroleum Safety Framework



(#) Petroleum Safety (Designation of Certain Classes of Petroleum Activities) Regulations 2013.
(+) Petroleum Safety (Petroleum incident) Regulations 2016.
($) and notifications.
Source: Information provided by CRU (March 2018).

Safety permits are issued for petroleum production, well work, combined operations and decommissioning. The CRU has issued three production safety permits that remain active, two in respect of the Kinsale Gas Fields and one in respect of the Corrib Gas Field. The CRU has also issued five well work safety permits; in each case the designated petroleum activity has concluded.

The CRU has also put in place an additional safety case assessment option specifically for non-production installations, whereby rig owners can apply to be assessed for an Acknowledgement of Compliance (AoC) for their non-production installation prior to a safety permit application. An AoC is confirmation that, at the time of the related non-production safety case assessment, the information submitted satisfied the requirements of the CRU Safety Case Guidelines. This AoC can then be submitted as part of a future safety permit application with the intent of making that assessment process more efficient for the owner. The CRU has issued 4 such AoCs.

Natural gas and liquid petroleum gas (LPG)

The scope of the relevant legislation includes the safety regulation of all natural gas undertakings, including storage, transmission, distribution, supply, and shipping. From 2014, the Framework also included the safety regulation of Liquefied Petroleum Gas (LPG) undertakings. Specifically, the CRU is charged with:

- regulating the activities of gas undertakings with respect to safety, including gas network operators and gas suppliers;
- regulating gas installers with respect to safety;
- promoting the safety of gas customers and the general public with regards to the supply, storage, transmission, distribution and use of natural gas.

The regulated entities include one natural gas undertaking licensed to operate both the natural gas transmission and distribution networks, two LPG safety licensed undertakings supplying LPG to final domestic customers through piped LPG distribution networks, and 27 (as of the end of 2018) shipper/suppliers licensed to either ship and/or supply natural gas to final customers.

Gas installers and electrical contractors

The CRU is responsible for the designation and oversight of the safety supervisory bodies charged with monitoring gas installers and electrical contractors carrying out domestic gas and electrical works, respectively. Additionally, if a registered electrical contractor carries out non-domestic electrical work they must certify it. The Registered Gas Installer (RGI) scheme is being extended in 2021 to include non-domestic gas works. The CRU is responsible for policy decisions with respect to safety, the overall operation of the regulatory scheme, enforcement and review of appeals regarding registration decisions and complaints.

The CRU appointed the Register of Electrical Contractors of Ireland (RECI) to operate Safe Electric, the statutory regulatory scheme for electrical contractors, and the Register of Gas Installers of Ireland (RGII) to operate the RGI scheme, the statutory regulatory scheme for gas installers, for 2016-2022.

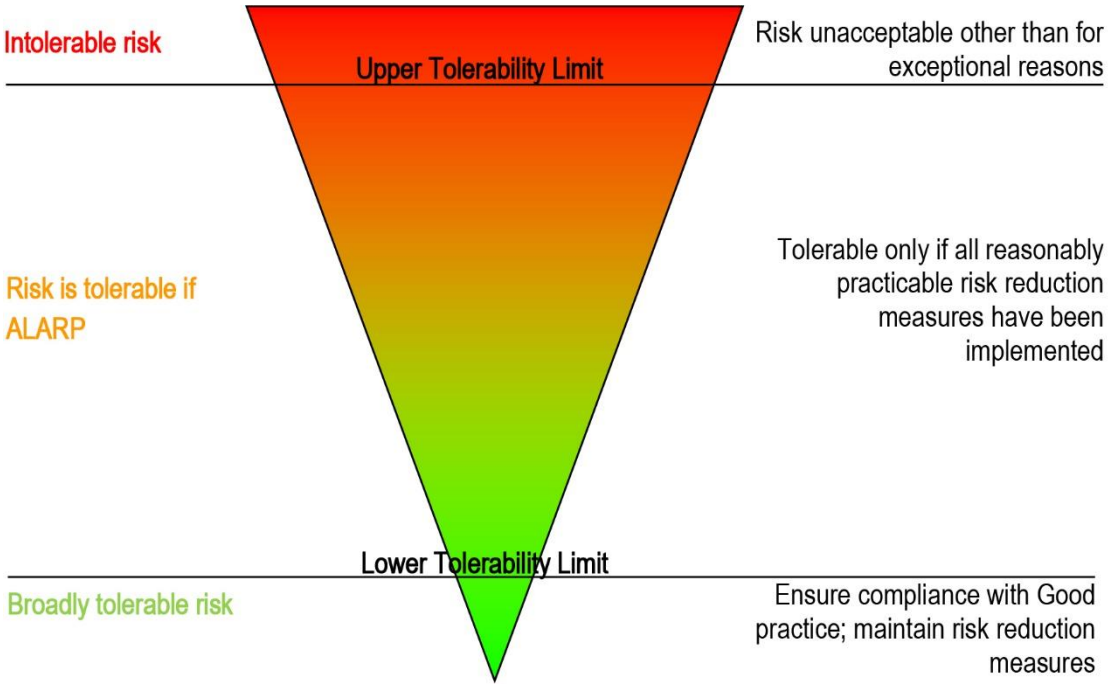
At the end of 2018, there were 2 999 gas installers and 4 122 electrical contractors registered with the RGI and Safe Electric schemes, respectively.

Approaches to safety culture

A key vision set by the CRU in its Strategic Plan 2019-2022 is to ensure that “energy is supplied safely.”

For petroleum and gas activities, the legislation places a fundamental obligation on owners and operators to ensure that the risk of all major accident hazards is reduced to a level that is “As Low As Reasonably Practicable” (ALARP) (Figure 5.2).

Figure 5.2. The "As Low As Reasonably Practical" (ALARP) Principle



Source: (CER, 2017[7]) ALARP Guidance – Part of the Petroleum Safety Framework and the Gas Safety Regulatory Framework, Version 3.1

The key tools that legislation assigns to CRU to foster petroleum and gas safety are:

1. Assessment of safety cases and issuance of safety permits/licenses;
2. Carrying out of audits and inspections;
3. Carrying out of incident investigations; and
4. Taking of enforcement actions.

In order to carry out a designated petroleum activity, a safety case must be submitted to the CRU for assessment. On acceptance of a safety case, the CRU issues an associated safety permit. Broadly speaking, designated petroleum activities are exploration, production and decommissioning and it is an offence to carry out these activities without a safety permit from the CRU.

Similarly, for natural gas and LPG activities, a gas safety case regime is applied to undertakings licensed by the CRU. This regime encompasses a risk and outcomes based approach to the management of gas safety risks whereby levels of risk are identified and managed to a level that is ALARP. Undertakings outline their adherence to the regime in a safety case submitted to the CRU for review and acceptance.

Where non-compliances with a safety case or the relevant legislation are identified, the CRU can take enforcement action. Non–compliances can be identified in any manner, for example, during an inspection or following an incident investigation. A number of enforcement options are available to the CRU under legislation, including the issuance of improvement notices and prohibition notices. These enforcement powers are progressive in nature to reflect the severity of the non-compliance identified. Failure to comply with these enforcement actions and other offences can result in fines and prosecution. Where the CRU is not satisfied that the holder(s) of a safety permit/licence is operating in accordance with the conditions of its permit/licence, the CRU can revoke the safety permit/licence.

In addition, for gas, a Gas Safety Promotion and Public Awareness regime is designed to increase the overall level of gas safety awareness amongst customers and the general public. Promotional activities are co-ordinated by the CRU and run by individual undertakings. The CRU, in conjunction with an industry group, the Gas Safety Promotion and Public Awareness Group (PAPA), chairs and oversees the development and review of national gas safety promotion and public awareness activities.

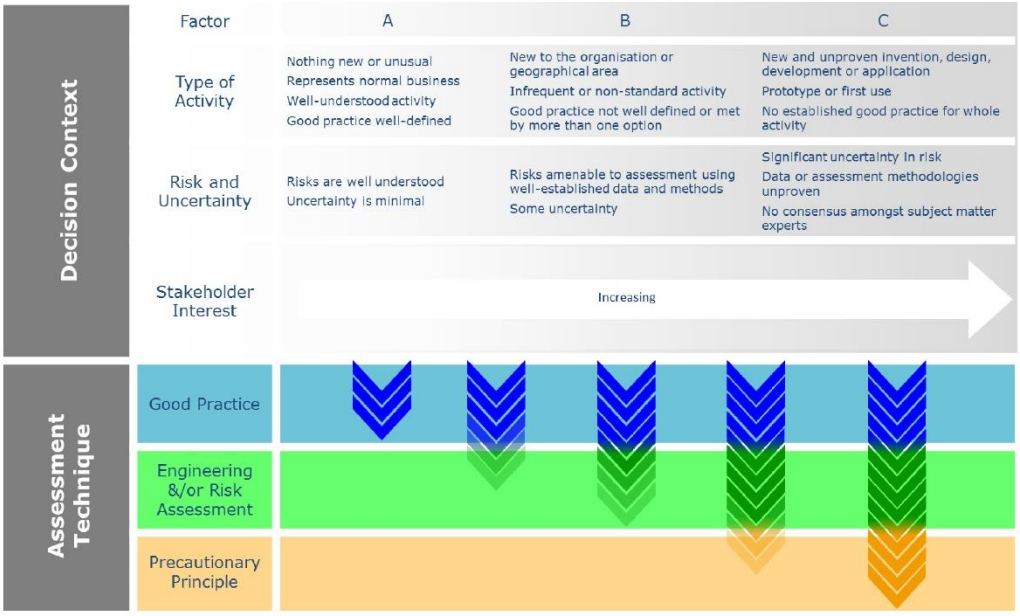
The approach is different for electrical contractors and gas installers. The first key step is registration. All electrical contractors and gas installers on the registers have been deemed competent to carry out electrical and gas works, respectively. They are insured and are subject to regular audit and inspection by Safe Electric and RGII. CRU exercises its powers to prosecute people who carry out electrical works and gas works when they are not registered as electrical contractors and gas installers, respectively, and those who portray themselves as registered contractors and installers when they are not. Finally, the CRU carries out activities to raise public awareness about the dangers associated with electricity and gas appliances and the need to use registered and competent contractors/installers when getting electrical and gas works done. Every time a contractor/ installer carries out domestic electrical/gas works, he is obliged to provide the customer with a completion certificate.

Assessing safety issues and risks

Safety cases

Prior to issuing a permit/license, the owner/operator must submit a safety case to the CRU for acceptance. The primary purpose of the safety case is for the owner/operator to demonstrate that adequate measures are in place to control the risk(s) of major accident hazards arising from the designated activities in such a manner as to reduce any risk to a level that is ALARP. The CRU has published detailed ALARP guidance to assist owners/operators in achieving compliance (CER, 2017[7]), including a decision process on assessing risks (Figure 5.3).

Figure 5.3. Decision process



Source: (CER, 2017[7]) ALARP Guidance – Part of the Petroleum Safety Framework and the Gas Safety Regulatory Framework, Version 3.1 (CER/16/106).

For petroleum safety, Directive 2013/30/EU (European Parliament, 2013[8]) requires that offshore safety cases must include a description of how workforce consultation and involvement has been achieved such that members of the workforce have the opportunity to contribute to the safety case and are able to arrive at informed opinions about the management of hazards to which they may be exposed on the installation.

Guidelines for safety cases recognise the importance of creating a safety culture in operators:

- The operator's or owner's Corporate Major Accident Prevention Policy (CMAPP), to be included in the safety cases, needs to include, among others:
  - measures for building and maintaining a strong safety culture, including through co-operation with workers, protection of whistle-blowers and working with safety representatives;
  - measures for rewarding and recognising desired behaviours including the reporting of accidents and near misses.
- Safety cases should identify procedures for internal communication among the various levels and functions of the organisation, including those required to enable the lessons from accidents to be learnt across the organisation (CER, 2016[9]).

Once received, the safety case is assessed by the CRU with the support of external technical expertise, as necessary.

Safety performance reporting and indicators

Operators and owners must monitor and report to the CRU on safety performance every quarter. For petroleum and gas safety, the safety performance indicators include both leading and lagging indicators. The petroleum safety leading indicators are produced from active monitoring of risk reductions measures to ensure their continued effectiveness (Table 5.1), and the lagging indicators relate to incidents. The CRU uses these data to monitor trends, recognise good practice and identify areas for audit and inspection.

Table 5.1. Leading safety performance indicators

ID	Safety performance indicator	Guidance
L1	Number of anomalies raised by ICB(s) in the quarter	Details of the anomalies raised are not required to be reported
L2	Number of verification anomalies that are not closed-out by the planned due date at the end of the quarter	
L3	Number of verification reservations raised by the operator or owner in the quarter	
L4	Number of S(E)CEs with overdue preventative maintenance at the end of the quarter	For this safety performance indicator, S(E)CEs are counted in terms of discrete items, e.g. if 10 gas detectors have not had planned maintenance completed, 10 is reported
L5	Number of S(E)CE maintenance hours required to clear any backlog in safety performance indicator L4	
L6	Number of live operational risk assessments at the end of the quarter	Operational risk assessments refer to risk assessments in place due to any impairment, loss or non-availability of an SCE or an abnormal situation
L7	Number of planned emergency drills not carried out within the quarter	

Note: SECEs = Safety and Environmentally Critical Elements
Source: (CER, 2017[10]), Compliance Assurance System – Part of the Safety Case Guidelines under the Petroleum Safety Framework, Version 4.1 (CER/16/016).

Verification

For petroleum activities, operators and owners must have in place Verification Schemes for verifying the suitability and performance of Safety and Environmentally Critical Elements (SECEs) and the maintenance of well integrity, by one or more organisations, termed an Independent Competent Body (ICB).

The operator and owner must submit its choice of ICB to CRU for acceptance in terms of their competence and independence. Where an ICB identifies a failure in either of the operator's or owner's system for maintaining well integrity, or the performance of an SECE, or the associated assurance processes, or the Verification Scheme itself, it must raise an anomaly. Where the ICB and operator/owner cannot agree on a suitable date for the closure of an anomaly, or on whether an anomaly has been suitably closed out, the ICB must raise a "verification reservation" to the operator/owner which they, in turn, must notify to the CRU. In this way CRU's attention is brought to issues relating to SECEs that cannot be resolved between the operator and the ICB. The Verification Scheme must be described or referenced in the Safety Case and must be sufficient to be able to judge whether the SECEs are initially and will continue to meet their performance standards, or well integrity is and will continue to be maintained. Verification records can be reviewed during audit and inspections. CRU can also inspect the verification body.

Audit and Inspection

Audits are based on examination and/or inspection of records, reports and other evidence produced or generated by an operator or owner relating to, for example, safety operation, safety performance, the Safety and Environmental Management System, and designs, including verification records, safety performance reports and Independent Safety Case Review reports (CER, 2015[11]).

For petroleum activities, inspections involve physical examinations of petroleum infrastructure, systems and parts of systems and are carried out by petroleum safety officers (PSOs) appointed by the CRU for this purpose. Audits and inspections are risk-based; the programme is determined annually and includes both scheduled and unannounced inspections.

For gas, the CRU has identified three type of inspection activities:

- internal safety audit and inspections, carried out by the undertaking;
- external safety audit and inspections, carried out by the CRU; and,
- detailed review of an undertakings' safety case, carried out by an independent body on a 5 year basis.

Tripartite consultation and confidential reporting

For petroleum activities, the CRU has established tripartite consultation between the CRU, owners and operators, and worker representatives to facilitate dialogue and co-operation. Each year the CRU hosts separate meetings for operators of production facilities and for those involved in exploration and well work activities.

Prior to the tripartite meetings, the CRU inspectors engaged with the worker safety representatives as part of their inspection process and this will continue to happen. CRU inspectors ensure the worker safety representatives are aware that they can communicate and raise relevant issues with the inspections team that will be dealt with accordingly.

Workers can also submit confidential reports of safety and environmental concerns to CRU via a CRU template that is required to be shared with all staff.

Communication

The CRU has also been promoting open communication to ensure that management is fully involved in and aware of safety requirements and issues. Both the Gas Networks Company and the two LPG undertakings have dedicated points of contacts for interacting with the CRU. Correspondence concerning inspections or enforcement actions is addressed to these dedicated contacts or senior management. In addition, the CRU Director of Energy Safety meets quarterly with the Managing Director of the Gas Networks Company to discuss any safety issues that have arisen during the previous quarter. The CRU also plans to provide more structured data from the regular monitoring of key performance indicators for consideration at this meeting. The CRU Commissioners also meet regularly with the Gas Networks Company and its parent company and important safety issues may be raised at that meeting. The Director of Energy Safety also meets at least annually with the managing directors of the two LPG undertakings, and more recently with the Association representing the LPG companies.

The criteria for operation and governance of the schemes for gas installers and electrical contractor is open to public consultation. A gas installer representative panel meets quarterly with the RGII and the CRU to discuss matters relating to the operation of the scheme. A similar electrical contractor representative panel is to be established in 2020. Annual roadshows are held for installers and contractors, these enable general discussions and question and answers sessions with the scheme operators and CRU. Additionally committees have been established to consult on and oversee the extension of the RGI scheme to include non-domestic gas works.

The Gas Safety Committee is chaired by the CRU and includes the Department of Communications, Climate Action and Environment, the RGII, the Competition and Consumer Protection Commission, the National Standards Authority of Ireland and regulated natural and LPG gas undertakings. The Committee facilitates the safe transmission, distribution and use of natural and LPG gas through the sharing of information at their meetings.

Behavioural barriers to safety culture

CRU responsibilities cover sectors which might face different safety challenges. Nevertheless, across these sectors, there seem to be some common behavioural barriers and challenges. Behavioural barriers include:

- ***Over-confidence/complacency***: this can be significant when an operator has faced no major incident for a number of years. It can be linked to a (misleading) belief that this is the result of robust systems or of the use of new or established technologies that, because their use is widespread, must ensure safety.
- ***Information bias***: all employees (including small installers and contractors) might underestimate how certain actions or failure to take action can impact safety.
- ***Framing***: deeper understanding of the importance of safety can be undermined by inconsistency/contradictions in messaging. This can come also from the number of regulators involved in the same sectors, if they are not joint up.
- ***Resistance to change and to being regulated***: Entities may have self-regulated or been subject to a “lighter touch” regulation in the past, sole traders tend to be particularly resistant to perceived additional bureaucracy
- ***Lack of committed safety leadership***: dilution/lack of consistency of safety messages may occur if relying on a third party to operate regulatory schemes, similarly lack of committed safety leadership may exist
- ***Lack of vigilance*** : investigations and actions are not taken in a timely manner
- ***Lack of resiliency***: underdeveloped professionalism/not aware of related risks.

Mexico's Agency for Safety, Energy and Environment

This section provides an overview of the role, approach and issues faced by the Agency for Safety, Energy and Environment (ASEA) in fostering a safety culture in the sectors it oversees. The purpose is to identify key behavioural barriers to creating a safety culture and methods and approaches identified by regulators to tackle these barriers. This section draws on information provided by ASEA as well as *Driving Performance of Mexico's Energy Regulators* (OECD, 2017[12]) and *Driving Performance at Mexico's Agency for Safety, Energy and Environment* (OECD, 2017[13]).

Overall role and institutional set-up

ASEA is a multi-disciplinary regulatory organism with the mission of guaranteeing the safety of the people and the integrity of the environment with legal, procedural and costs certainty in the Hydrocarbons Sector.

While the overall contribution of the oil sector to the country's GDP has decreased considerably over the years (from approximately 10% in 1996 to 5% in 2016), the sector continues to hold significant weight in the country's political and economic agenda and was the subject of a major structural reform in 2013-14 that included the opening of the hydrocarbons sector to foreign and private operators, effectively ending the monopoly of state-owned PEMEX (OECD, 2017[14]).

The regulator was established with the enactment of the ASEA Act in August 2014, as part of Mexico's ambitious energy reform that opened the hydrocarbons sector to private and foreign operators. Since becoming operational in March 2015, ASEA has tackled complex transfers of responsibilities and powers from other federal entities and states and, in the area of industrial and operational safety, has had to regulate in an area previously self-regulated by PEMEX.

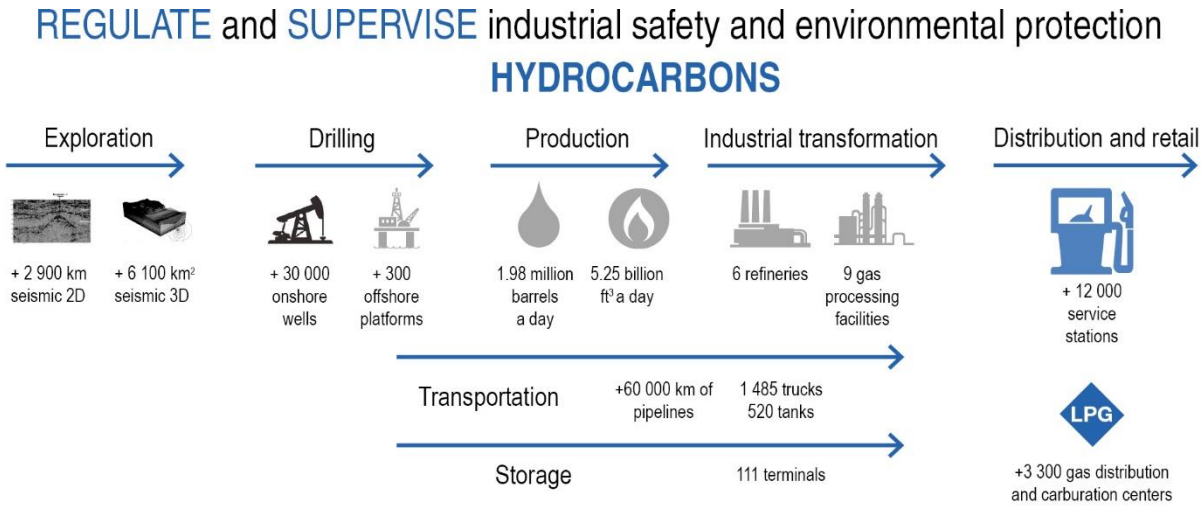
ASEA is a deconcentrated agency of the Ministry of Environment and Natural Resources (SEMARNAT). It has technical and managerial independence, but is dependent of the Ministry for financial and budgetary aspects. During its first years of operation, ASEA has been financed by the executive, although it is foreseen that, in the upcoming years a great portion of its funding will come from the payments made from Regulated Entities by the concept of paperwork management & non-compliance fines. The Executive Director of the Agency is directly appointed and can be removed by the President of Mexico.

Since September 2017, ASEA forms part of the System of Energy Regulators that it established jointly with the Energy Regulatory Commission (CRE) and the National Hydrocarbons Commission (CNH). The joint system aims to regulate and supervise sector activities in a reliable and co-ordinated manner in order to promote productive investments and the energy sector's efficient and sustainable performance for the benefit of Mexico. A number of joint initiatives, including the opening of the one-stop-shop Bureau for Co-ordinated Assistance to the Energy Sector (ODAC) that provides information to sector stakeholders in areas that involve more than one regulator, have already been carried out by the co-ordination body.

Safety responsibilities

ASEA is the safety regulator of Mexico's hydrocarbons sector. It oversees activities throughout the hydrocarbons value chain, from upstream exploration and extraction to midstream and downstream transformation, production and storage, as well as distribution and retail at petrol station level (see Figure 5.4). This breadth of responsibilities makes ASEA internationally unique.

Figure 5.4. Functions of the Agency for Safety, Energy and Environment (ASEA)



Source: (OECD, 2017[13]), Driving Performance at Mexico's Agency for Safety, Energy and Environment, OECD Publishing, Paris (updated in March 2018 based on information provided by ASEA).

More specifically, the ASEA Act, August 2014, assigns amongst others the following functions to the Agency:

- Contribute technical elements relative to industrial and operational safety and the environment protection, to the competent authorities, for environmental and energetic policies of the country.
- Collaborate with the distinct government organisms, dependencies and competent entities, in the design and attention of the national and international prevention plans to attend the emergency situations in the Sector activities.
- Regulate, supervise and sanction on industrial and operational safety and environmental protection matters, in relation to the Sector activities, including the stages of dismantling and abandonment of the facilities and the integral control of waste and atmospheric emissions.
- Set the guidelines for the conformation and operation of the SEMS that the Regulated Entities must have and, authorise said SEMS.
- Supervise and watch over the compliance by the Regulated Entities of the legal and regulatory systems and norms applicable to the subjects of their competence.
- Authorise Agency´s public servers and accredit natural or legal persons to carry out supervisions, inspection and verification activities, technical evaluations and investigations, as well as certification and audits activities.
- Impose safety measures, precaution measures or sanctions that are applicable to the corresponding legislation.
- Carry out root cause analysis in case of operational, industrial and environmental incidents and accidents, according to the issued guidelines or set the basis for the Regulated Entities carry out their own analysis, as well as the risk and lessons learned communication.
- Issue, suspend, revoke or deny licenses, authorizations, permits and records in environmental matters.
- Boost sustainable regional development and demand that the related Sector activities are performed with protection, conservation, compensation and restauration of the ecosystems, including flora and fauna, environmental services, in coordination with the competent administrative units.

Approaches to safety culture

Notwithstanding its enforcement powers, the Agency pursues a strategy that favours compliance over punishment, as well as performance or results-based technical regulation over prescriptive regulation. These approaches underlie ASEA's approach to safety culture in the hydrocarbons sector.

Safety culture is understood as the set of beliefs, values, attitudes and behaviours that a group of people has in common with respect to the management of risk and safety; consequently, ASEA promotes within industry the understanding that the risk management is a regular practice that benefits entities' own performance.

The Safety and Environmental Management System (SEMS) that regulated entities are obligated to design, submit for authorisation by ASEA and implement constitute the corner stone of this framework. The SEMS is a set of interrelated and documented elements that cover the entire life cycle of the regulated entity's facilities with the overall purpose of prevention, supervision and improvement in the areas of industrial and operational safety and environmental protection.

ASEA emitted secondary regulation on SEMS for upstream and midstream activities in May 2016 (SASISOPA), covering activities linked to exploration and extraction of hydrocarbons; refining, transportation and storage of oil; transportation, storage and distribution of natural gas; transportation and storage of Liquefied Petroleum (LP) gas; transportation and storage of petroleum.[3] Further to this, ASEA emitted secondary regulation on SEMS for downstream and retail in June 2017, covering activities linked to the sale to the public of natural gas; distribution and sale to the public of Liquefied Petroleum Gas; distribution and sale to the public of petroleum products.[4]

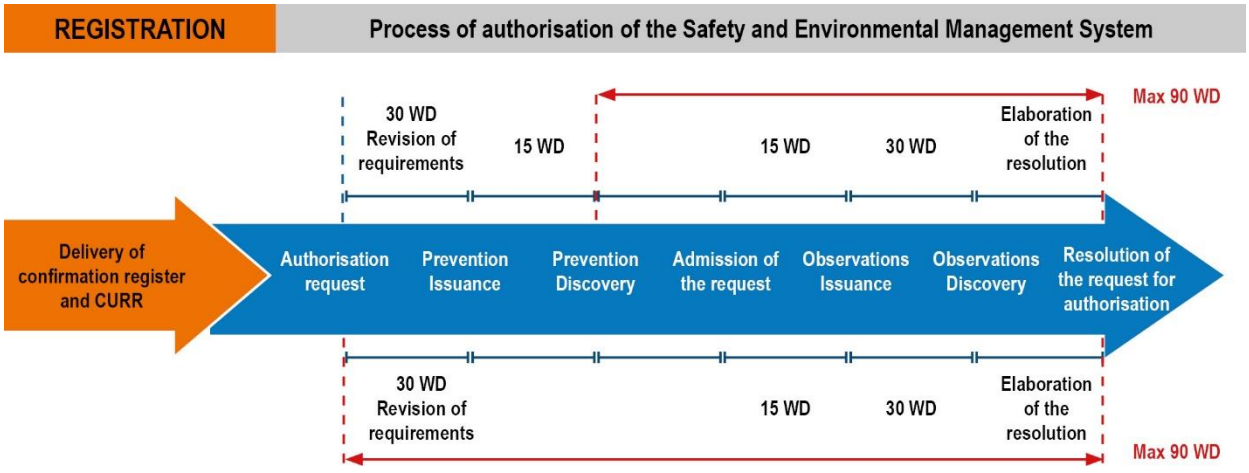
As per these regulations, regulated entities need to count with the authorisation of their SEMS by ASEA before initiating any activity in the building stage. The process of authorisation of SEMS is expected to be carried out over 90 working days by the Agency, as per the steps described in Figure 5.5.

The SEMS is intended as a dynamic framework based on continuous improvement that will guide the activities, supervision and learning of the regulated entity. Operators are required to have a dedicated unit in charge of the implementation, evaluation and improvement of the SEMS, with necessary written procedures, computer tools, and management platforms that are to be implemented in a constant and consistent manner. In addition, a number of assessments are required to be carried out by external parties (external audits by third parties). Following authorisation of an entity's SEMS by ASEA, regulated entities are required to submit the following reporting to the Agency:

- Semi-annual compliance reports of the SEMS Implementation Program.
- An annual performance report based on the indicators of the SEMS (must be delivered during the first quarter of the year).
- Biannual reports on the results of the external audit carried out on the SEMS.

Importantly, regulated entities are required to consider organisational culture and job satisfaction in the fields of industrial safety and environmental protection, and the effectiveness of processes for employee participation as essential dimensions for the success of SEMS (Article XXXII.3.c) and e) of SASISOPA). Furthermore, ASEA requests regulated entities to implement mechanisms to promote openness and culture of disclosure of incidents and accidents (Annex IV, Section B, Article VIII.3) of SASISOPA).

Figure 5.5. Authorisation process for Safety and Environmental Management Systems (SEMS) by ASEA



Note: Acronyms refer to working days (WD) and the Regulated Unique Reference Code (CURR in Spanish).
Source: Information provided by ASEA, 2018.

Given the recent entry in vigour of SEMS related regulation and requirements, ASEA had not yet received reports from regulated entities as of 2018 for Systems approved in 2016. The Industrial Management and Planning Units of ASEA published guidelines with regard to SEMS indicators (13.b) in December 2019. ASEA plans to use data from these indicators in its Annual Report on Safety Performance.

Finally, the SEMS must be rooted in the Policy of Regulated Entities that commits the regulated entity and staff to perform the identification of safety issues as a constant activity. It is to be formulated by the senior management of the regulated entity and is to include the following elements, in the shortest document possible:

- Nature of risks and environmental concerns linked to the entity's activity;
- Framework for the definition of the objectives of the entity's SEMS;
- Commitment to the assessment of risks and environmental impact and to compliance with the normative framework on behalf of the regulated entity, its contractors, subcontractors, providers and service providers;
- Commitment to continuous improvement in performance for industrial and operational safety and the protection of the environment.

Once formulated, this policy is signed by the regulated entity's senior management signalling leadership commitment to safety values. It will be distributed to all staff, as well as contractors, subcontractors, providers and service providers in the form of flyers.

Technical managers will also be required to communicate the contents of the policy to staff and teams via weekly chats, using flyers or other materials to support these conversations for effective communication aiming to enhance safety culture. These suggestions are included in guidelines prepared by ASEA and published online.[5]

Assessing safety issues and risks

ASEA definition and approach to assessing safety issues and risk

Risk assessment is a task performed by the regulated entity from the moment it presents its SEMS for assessment and authorisation by ASEA. It is regarded as a process performed by the regulated entity, according to the methodology of its choice, to estimate the probability and magnitude of the identified risks.

Risk is understood by the Agency as the probability of occurrence of an unwanted event and is measured in terms of its consequences to the people, facilities, environment or community.

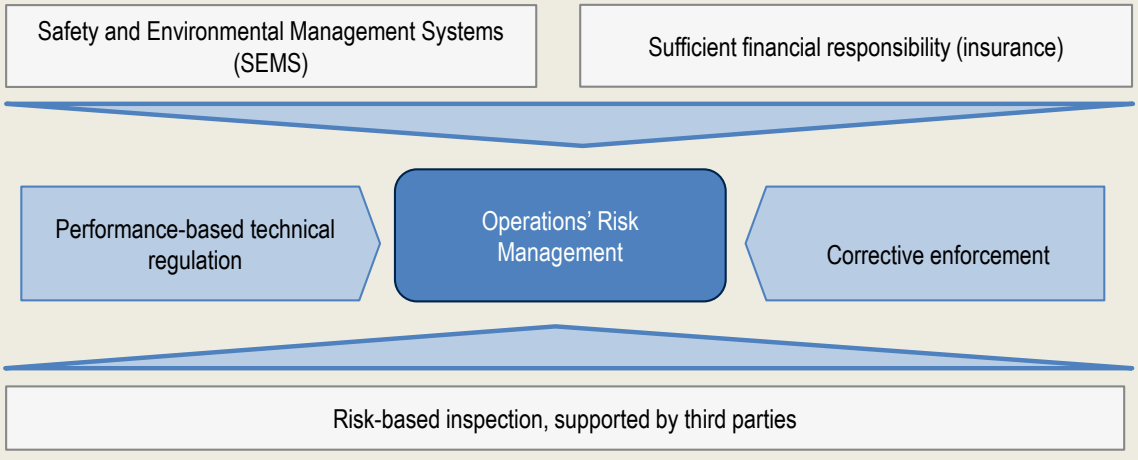
The Agency does not distinguish between actual and potential risks because the risk itself is a probability; however, it does distinguish critical risk. A critical risk implies an imminent danger and requires immediate action to reduce the risk to an acceptable level without limiting the cost of its solution.

Box 5.1. ASEA risk-based management model

ASEA implements a risk-based management model to tackle its ample responsibilities and target its resources in the most efficient manner. This model is based on five pillars:

- Regulated entities are requested to design, implement and report on Safety and Environmental Management Systems (SEMS), which include risk assessment and strategies that are followed up on a yearly basis.
- ASEA prioritised emitting regulation on regulated entities' insurance requirements, to ensure sufficient financial responsibility in case of incidents or accidents.
- ASEA favours performance-based rather than prescriptive regulation, allowing for innovation by industry.
- ASEA favours corrective enforcement over sanctions, emitting recommendations for corrective measures designed to decrease risk.
- Inspections are fielded according to analysis of the level of risk, targeting high-risk sites, and are supported by accredited third parties.

Figure 5.6. Risk management model



Source: (OECD, 2017[13]), Driving Performance at Mexico's Agency for Safety, Energy and Environment, the Governance of Regulators, Paris. Based on information provided by ASEA in 2016.

Risk and hazard identification in regulated entity policy and SEMS

The Policy of the Regulated Entity as well as the SEMS are required to include the identification of safety issues. The identification of hazards and risk analysis should be carried out in routine activities, based on the application of internationally accepted methodologies, as well as in non-routine activities. Risk assessments must include necessary mitigation, prevention and control measures to reduce the identified risks.

In continuous operations, the regulated entity must update its hazard identification at least every five years or in case of an accident. The Agency requires the regulated entity to deliver, during the execution of its SEMS Implementation Program, the following documents:

1. The list of mechanisms used to identify hazards.
2. Documentary evidence of the team members' technical competences.
3. The five-year programme for updating hazard identification.
4. The list of dissemination and communication mechanisms of the results derived from the identification of hazards to its staff, contractors, subcontractors, service providers and suppliers.

It is important to emphasize that the results of the risk analysis must be included in the operation, maintenance and inspection procedures; as well as emergency response plans. In all this, the regulated entity must document the follow-up that is made to the actions and recommendations derived from the risk analysis.

By law regulated entities are required to involve external parties in their risk assessment activities, by external audits of their operations as well as inspections carried out by third parties. ASEA has the authority to authorise third parties to carry out inspections on its behalf as per the Official Mexican Standards and in the General Administrative Provisions issued by the ASEA. ASEA supervises third parties according to a schedule designed by its Unit of Inspections, which consists of both a documentary and *in situ* assessment.

Inspections by the regulator

ASEA's risk-based inspections framework is informed by data from three sources: i) risk evaluations and inspections by regulated entities as part of the SEMS implementation programme: ii) inspections by insurance companies; iii) inspections by ASEA targeting high-risk sites based on an analysis of the previous information.

When ASEA inspectors detect regulatory breaches they strive to close the detected gap and reduce the likelihood of its recurrence. Information on potential breaches is written up in the Inspection Act that is shared with the regulated entity. These normative breaches in the actions of the regulated entities and the third parties are detected from:

- Risk analysis in which it is possible to evaluate the protective barriers and reduce the risk.
- Incident and Accident Statistics.
- Complaints and Complaints.
- Analysis of Root Cause Investigations and their recommendations.
- Results of previous verifications.
- Compliance with corrective measures, urgent application measures and security measures.
- Compliance with the conformity assessment procedure.

Behavioural barriers to safety culture

Some of the key challenges faced by ASEA in addressing the emergence of a safety culture in the sector are:

- The recent establishment of the regulator and its on-going work defining the safety conditions of the sector, including covering regulatory gaps;
- The ample scope of activities and types of operators in different stage of the hydrocarbons value chain regulated and supervised by ASEA, their geographical distribution, the number of operators and third parties as well as the level of required expertise to inspect their activities;
- Effective communication of the regulator's approach that compliance over penalty to regulated entities;
- Establishing safety culture at all levels of regulated entities;
- Establishing professional responsibility in third parties authorised to inspect and evaluate operator performance by ASEA, and ASEA's ability to monitor and verify the performance of the third parties;
- Defining indicators to measure safety culture, communicate those indicators and verify their proper compliance;
- Achieving the perception of safety as an investment that carries benefits, advantages and opportunities for business.

Oman's Authority for Electricity Regulation

This section provides an overview of the role, approach and issues faced by the Authority for Electricity Regulation (AER) in fostering a safety culture in the sectors it oversees. The purpose is to identify key behavioural barriers to creating a safety culture and methods and approaches identified by regulators to tackle these barriers. This section draws on information provided by the AER.

Overall role and institutional set-up

The AER is an independent regulator with economic and technical functions and duties in Oman's electricity sector and related aspects of the water sector. It was initially established by Article (19) of the Law for the Regulation and Privatisation of the Electricity and Related Water Sector (2004) and amended by Royal Decree 59/2009 and 47/2013 on the Sector Law.

The AER's statutory functions and duties under the Sector Law are to protect the interests of customers, companies, and the government. Its principal duties according to Article (22) of the Sector Law are as follows:

- Ensure security of electricity and related water services in Oman;
- Promote competition in the electricity and related water sector
- Ensure safe, effective and economic operation of the electricity and water sector in the interest of the public;
- Protect and serve in the interest of vulnerable customers;
- Ensure compliance with government policies regarding environmental protection, Omanisation and Omani Content [6];
- Ensure Licensees meet all reasonable demands relating to financial and technical capabilities;
- Facilitate the privatisation and liberalisation of the electricity and related water sector;
- Guarantee fair and transparent competitions held by Oman Power and Water Procurement Company (OPWP) in procuring new generation capacity;[7]

- Provide advice to Ministries and the Public Authority for Electricity and Water (PAEW);
- Conduct an annual review on the scope for further privatisation and liberalisation of the electricity and related water sector;
- Prepare and maintain a Public Register of licenses, exemptions and such related matters

The AER manages its budget independently and reports directly to the Council of Ministers.

Safety responsibilities

The AER's safety responsibilities include to securing and developing the safe, effective and economic operation of the electricity and related water sector, and enhancing the safety of the public in relation to sector activities.

Key safety functions include:

- Conducting Health and Safety audits of Licensees' safety policies, plans, processes and procedures according to their statutory obligations
- Investigate safety-related incidents, mainly in the event of accidental death
- Reviewing significant incident reports in the sector
- Investigate technical incidents as required to ensure system performance

Health and Safety Audits

AER periodically undertakes Health and Safety audits of all regulated entities under its mandate. The frequency of formal audits is determined according to routine monitoring of performance and behaviours. For its upcoming 2018 Work Programme, the AER plans to conduct Health and Safety audits of Oman Electricity Transmission Company (OETC), Oman Power and Water Procurement Company (PWP) and Dhofar Power Company (DPC) (AER, 2017[15]). The audits are focused on the health and safety performance of Licensees at all levels, including the activities of the companies under their contract. Audits include reports to and decisions taken by the Board of Directors to administer and implement Health and Safety rules at the operational level.

Regulation of Electric Vehicles

In accordance with its 2018 Forward Work Plan, the AER carried out a review of international best practices relating to a regulatory framework to support the introduction of electric vehicles in Oman (AER, 2017[15]). As part of this review, the AER looked into safety issues associated with electric vehicles. The study was conducted in 2018.

One of the outcomes was identification of safety requirements for connecting EV charges which was embedded in the new update of the Wiring Regulations (known as Oman Electrical Standard 4 "OES4"). Edition 3 of OES4 was approved by the Authority which is intended to come to effect in January 2020.

Environmental Compliance

Prior to issuing licenses, the AER requires Licensees to take due account of applicable environmental standards prevailing in the Sultanate of Oman and establish a written policy on protecting the environment from harmful effects of its licensed activities, together with the operational and management arrangements for its implementation. Although overall environmental compliance is the responsibility of Ministry of Environment and Climate Affairs, the AER has previously audited the environmental performance of network licensees.

Approaches to safety culture

Ensuring the safety and security of the electricity and related water sector in the interest of the public, companies and government is one of the key mandates of the AER. The key tools that legislation assigns to AER to achieve safe and secure electricity and related water provisions include:

1. Issuing licenses to operate/deliver activities in the sector;
2. Carrying out audits and inspections;
3. Carrying out incident investigations; and
4. Taking enforcement actions including fines

Non–compliances with health and safety obligations are typically identified by audits and inspections, or following a safety report or incident investigation.

Where non-compliances with a safety case or the relevant legislation are considered to be a breach of a Company's licence, the AER can issue a notice to secure improvements. A number of enforcement options are available to the AER under legislation, including the issuance of improvement notices and fines (although fines are only permitted for instances where a company fails to comply with the terms of a breach of licence notice).

The Authority has used a variety of regulatory tools to secure improvements, including issuing breach of licence notices, imposing fines, and refusing to issue a licence to a company until health and safety concerns are fully addressed. According to the Sector Law, if it is revealed to the AER that a Licensee or exemption holder is violating or likely to violate a condition of the license or exemption, or any of the duties imposed on him pursuant to the provisions of the law, the AER has the right to revoke a license or exemption in case the holder of a license or exemption abstains from implementing the decisions issued by the AER in respect to the violations. The AER has not yet revoked a license or exemption, although it has in the past refused to issue a license or exemption until the company applicant improved its health and safety performance. The Authority is presently in the process of formalising regulations to allow for immediate penalties for unsafe electrical installations.

It appears that AER both regularly and informally communicates with senior management of regulated entities about health and safety concerns, considerations, and recommendations. However, AER correspondences with regulated entities suggest that regulated entities have tended to respond to concerns raised by AER on a case-by-case basis rather than on a systematic or pre-emptive basis. However, although the AER thereby appears to expend significant efforts and resources to actively and continuously supervise regulated entities for chronic infringements, the AER has identified more sustainable risk identification and management processes that licensees have started to implement.

Assessing safety issues and risks

Health and Safety Management Plans

Licenses with operators and owners require a written Health and Safety policy, including details of implementation and management arrangements. The content of the policy are at the discretion of the Licensee.

Some Licensees have pursued international certifications in Integrated Management System to demonstrate Health, Safety and Environment (HSE) performance. However, it is not clear to what extent the pursuit and/or achievement of such certifications are sufficiently reflected in HSE safety practices or working culture on the ground.

Safety performance reporting and indicators

According to the Distribution Code (Distribution Operating Code DOC5) and the Grid Code (Operating Code OC6), Network Licensees shall review their Safety Rules every twelve months.

Each Network Licensees shall prepare a report of each review, which should summarise the relevant events that have been considered as part of the review. The report may recommend changes to the Safety Rules, the implementation of the Safety Rules, or amendments to the codes of practice to support the Safety Rules. The report shall be presented to the Distribution Code Review Panel for consideration and review, and then presented to the Grid Code Review Panel and the AER for overall consideration of Safety Rules.

The AER examines the H&S performance of Licensees against the requirements of the license.

The overall safety performance of the electricity and related water sector has improved dramatically since 2005. However, the individual performance of Licensees varies from one to another. With regular monitoring, it is expected that safety performance will continue to improve.

Audit and Inspection

For the electricity and related water sector, the AER has identified three types of inspection activities:

- internal safety audit and inspections, carried out by the Licensee;
- external safety audit and inspections, carried out by the AER; and,
- third party auditing

Self-audits by Licensees are typically based on examination and/or inspection of records, reports and other evidence produced or generated by an operator or owner relating to safety operation or performance, including performance reports and verification records.

AER audits, inspections and communications may be done formally or informally, and may involve scheduled and/or unscheduled physical inspections of electricity installations, including equipment. Investigations may be conducted by a technical team within the AER or by external consultants, depending on the severity or complexity of the issue or incident.

AER may also contract third party consultants to undertake audit and inspection.

Time-dated photographs may be taken as evidence of health and safety infractions. If installations are assessed by the AER to constitute a health or safety risk, the Licensee may be subject to fines ranging from 500 to 1000 Omani Rial (USD 1 300 to 2 600) per infraction. The AER may send such photos to Licensees with requests for remedial actions and/or to accompany notices of fines will be issued for health and safety infringements.

Licensees are responsible for ensuring compliance of health and safety rules and standards by staff, contractors and consultants. Licensees do not always and may not be able to impose financial penalties on contractors found in breach of health and safety rules. In the past, this has been because Licensees and contractors do not always operate on formal contracts or work permits, or the issuance of contracts or work permits to contractors have not given sufficient weight to health and safety performance. However, health and safety is generally considered at the contract award stage, and penalties are imposed for non-compliance with the relevant requirements.

Health and safety workshops

Health and safety workshops are occasionally conducted for Licensees and exemption holders, including network companies. Health and safety concerns, as well as best practices, could be discussed and presented in such workshops.

Behavioural barriers to safety culture

AER responsibilities cover sectors which might face different safety challenges. Nevertheless, across these sectors, there seem to be some common behavioural barriers and challenges. Behavioural barriers include:

- ***Over-confidence/complacency***: this can be significant when an operator has faced no major incident for a number of years. It can be linked to a (misleading) belief that this is the result of robust systems or of the use of new or established technologies that, because their use is widespread, must ensure safety.
- ***Information bias***: all employees (including small installers and contractors) might underestimate how certain actions or failure to take action can impact safety.
- ***Responsibility deflection***: inspection reports suggest that regulated entities readily deflect the responsibility of HSE breaches to contractors, even where the AER and other inspectors confirm that said breaches are attributable to the regulated entities. In some cases, managers have also deflected responsibility to lower level staff on the grounds that the staff has received delegated authority to ensure compliance with HSE rules.

It does not appear to be uncommon for the AER to find that staff, contractors and consultants working for Licensees have not been formally trained on company safety rules, or in some cases have never read them.

Other times, staff, contractors and consultants are familiar with the basic requirements of various safety standards, including the Oman Electrical Standards, but are little motivated to ensure their full compliance. Staff and contractors have been observed to comply with safety requirements only when inspector or auditors are around; once the checks are over, it is business as usual.

Previous investigations have revealed systematic failures to apply operational safety procedures on the part of Licensee. While all Licensees appear to have company-wide electricity safety rules, they are neither consistently applied nor enforced; in some cases they have been blatantly ignored. Furthermore, companies are not always able to provide evidence that safety rules have been adequately taught and/or learnt by all relevant staff, or that all relevant staff have seen or received a copy.

Possible reasons that have been identified in AER or incidence reports to explain low or non-compliance with safety rules and procedures include:

- **Weak leadership from executive management to support and prioritise HSE improvements in the workplace**. For example, in at least one company, senior management and other managers responsible for safety have failed to attend a scheduled meeting with the AER to discuss HSE performance;
- **Perceived lack of clarity on the requirements and application of safety rules among staff**;
- **Fatigue on the part of key personnel who have had to work long hours**. At least one panel report recommended a review of the number of competent, authorised and senior authorised persons responsible for ensuring health and safety, particularly with regards to current and future workload, and including an assessment of the effects of excessive working hours on worker safety;
- **Lack of clarity on roles and responsibilities for HSE performance**, including who is authorised to operate or test certain activities, or who had the authority to issue or cancel such permissions;
- **Staff, contractors and/or consultants operating at levels exceeding their competence or understanding.**

AER and third party auditors/inspectors have attempted to encourage greater safety compliance by sharing peer performance evaluations with Licensees. In at least one external audit, a Licensee's company activity performance – including in HSE and risk categories – has been compared against the performance of their

peers'. It is unclear to what extent Licensees have been encouraged to improve their safety behaviour or practices after seeing their relative performance ranking vis-a-vis other license holders.

Notes

[1] Case studies were also collected from the Korea Occupational Safety and Health Agency that focuses on workplace safety (including construction and manufacturing) and the United Kingdom's Office for Rail and Road, which focused on railway safety. Insights into behavioural biases in their sectors was included in the below analysis. For the sake of consistency with the experiments, the cases were omitted from this publication.

[2] Petroleum (Exploration and Extraction) Safety Acts 2010 and 2015.

[3] Lineamientos para la conformación, implementación y autorización de los Sistemas de Administración de Seguridad Industrial, Seguridad Operativa y Protección al Medio Ambiente aplicables a las actividades del Sector Hidrocarburos https://www.gob.mx/cms/uploads/attachment/file/257218/dacg_sasisopa_dof_13_may_2016.pdf.

[4] Lineamientos para la conformación, implementación y autorización de los Sistemas de Administración de Seguridad Industrial, Seguridad Operativa y Protección al Medio Ambiente aplicables a las actividades de Expendio al Público de Gas Natural, Distribución y Expendio al Público de Gas Licuado de Petróleo y de Petrolíferos. https://www.gob.mx/cms/uploads/attachment/file/231626/2017_06_16_mat_semarnat2a_sasisopa_expendio.pdf.

[5] Guía para la conformación del sistema de administración de seguridad industrial, seguridad operativa y protección al medio ambiente aplicable a las actividades de expendio al público de gas natural, gas licuado de petróleo y petrolíferos https://www.gob.mx/cms/uploads/attachment/file/264154/gu_a_sasisopa_validada_final.pdf.

[6] Omanisation refers to the Government's policy for employing Omani nationals, and Omani Content refers to the use of Omani materials.

[7] OPWP is the single buyer and seller of electricity and related water.

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Behavioural Insights and Organisations

FOSTERING SAFETY CULTURE

Behavioural insights (BI) has become widely used by public bodies around the world, mostly towards improving the way policies are implemented and influencing individual behaviour. As the field of BI evolves to tackle more complex policy issues, there is widespread perception that BI can and should go beyond the study of individual-level decision processes for higher impact. This report presents research on applying BI to changing the behaviour of organisations, with a focus on fostering elements of a safety culture in the energy sector. It presents comparative findings from experiments with energy regulators in Canada, Ireland, Mexico and Oman, as well as guidance for applying BI to safety culture going forward.

Consult this publication on line at ***https://doi.org/10.1787/e6ef217d-en***.

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