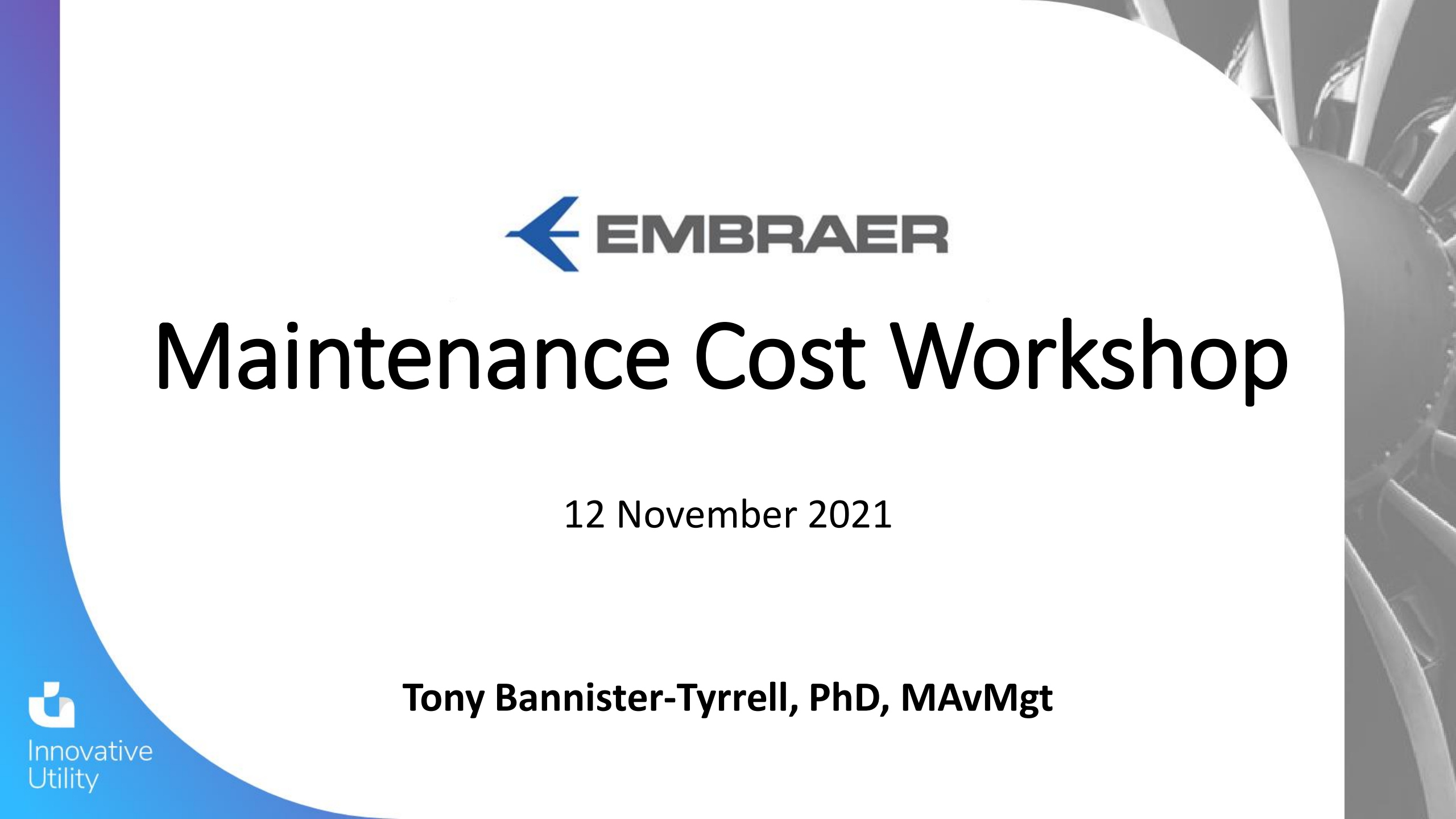

Maintenance Cost Workshop

12 November 2021

Tony Bannister-Tyrrell, PhD, MAvMgt

Innovative Utility

Positive deviance: Taking a systems safety approach to innovative violations

Capturing, **Codifying**, and **Controlling** *innovative violations* by applying new thinking to the drivers of positive deviance behaviour

Innovative Utility

Practitioner not Academic

Brief outline of my aviation career:

- 1979: I joined the Royal Australian Air Force as a mechanic/maintenance engineer
- 1987: Moved into maintenance management, engineering and integrated logistics management roles
- 2005: Appointed as a Senior Maintenance Manager (SMM) for an aircraft heavy maintenance organisation (civilian/commercial/contractor role)
- 2010: As the SMM I developed and implemented an aviation safety management system. I also functioned as the inaugural Aviation Safety Manager
- 2014: Completed a Masters of Aviation Management (University of Newcastle)
- 2020: awarded my PhD (School of Psychology, University of Newcastle)

I thoroughly enjoyed the research component of my PhD candidature, but I am not an academic.

My focus is firmly set on achieving practical solutions to aviation maintenance problems and with improving aviation safety management practices.

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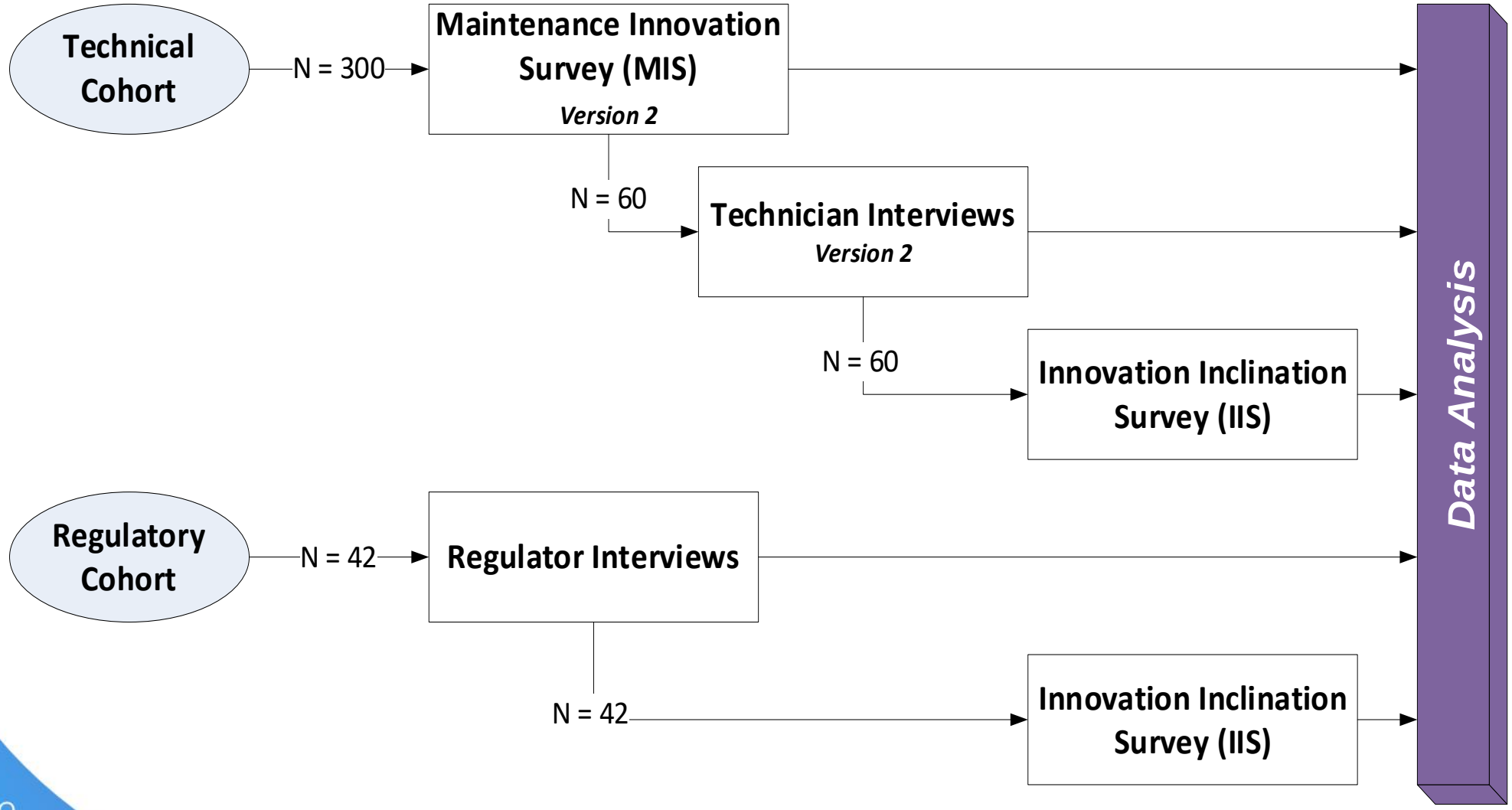
Context of my PhD research



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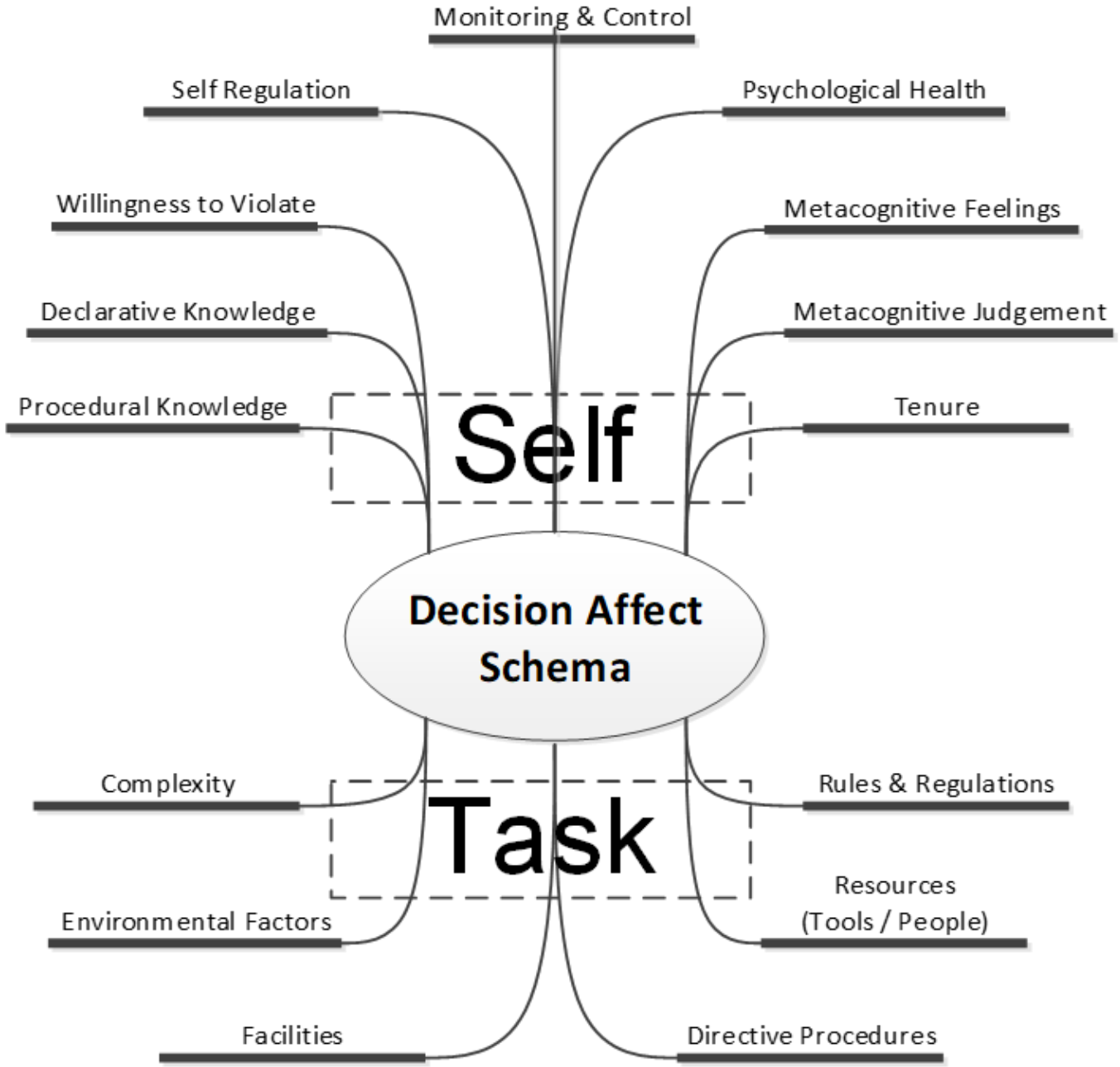

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Innovative approaches to maintenance

In the context of aviation maintenance, innovation was defined as doing a task:

- a better way
- a more effective or efficient way
- a safer way

Innovative Utility

Innovative approaches to maintenance

In the context of aviation maintenance, innovation was defined as doing a task:

- a better way
- a more effective or efficient way
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90% of survey participants (N=270) stated that they had a strong self-belief in their technical abilities which allowed them to identify innovative maintenance solutions

78% of survey participants (N=232) felt that they were innovative maintainers

41% of survey participants (N=122) agreed that there were always better ways of doing a task than that described in the maintenance publication

34% of survey participants (N=102) indicated that the time spent in their current job allowed them the flexibility to work independently of the maintenance procedures

Innovative Utility

Violation pathways

A violation, in its simplest form, is any action that deviates from an approved maintenance procedure without appropriate approval. Hence, even minor innovations must be classified as violations.

93% of survey participants (N=278) stated that adherence to rules and regulations was a key message from the organisation's management. Yet, despite that:

- 45% of survey participants (N=136) indicated that maintenance publications seldom provide all the instructions required to complete complex maintenance tasks.
- 36% of survey participants (N=108) identified that maintenance publications were difficult to understand and follow
- 24% of survey participants (N=71) indicated they used unapproved or unauthorised reference material (Black books / aide-memoires / personal notebooks etc.)

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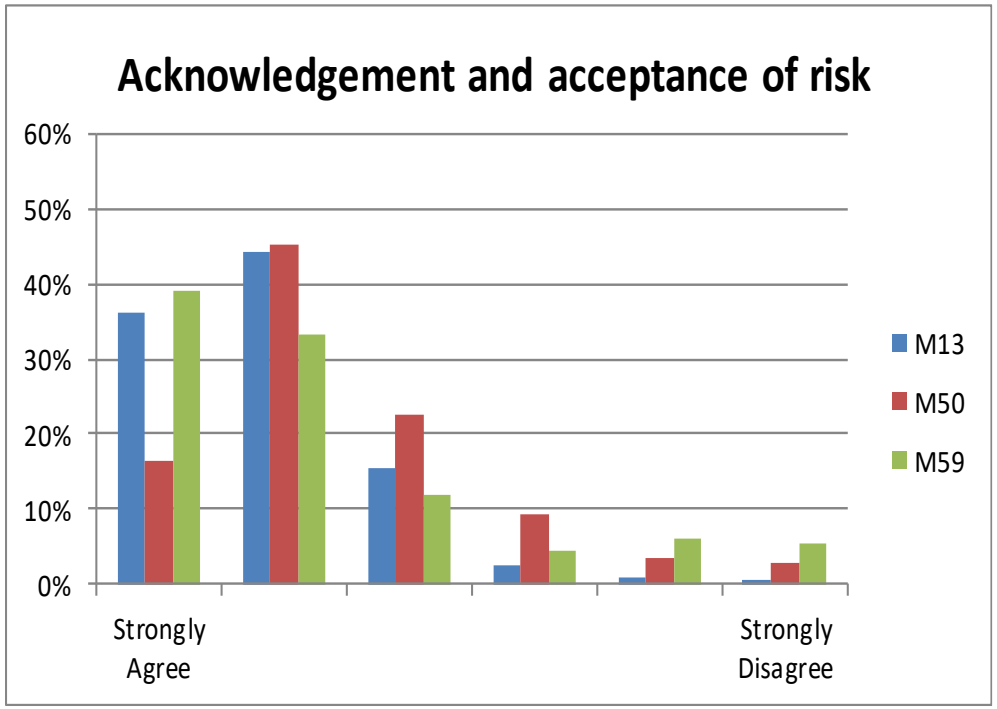
Tolerance and acceptance of risk



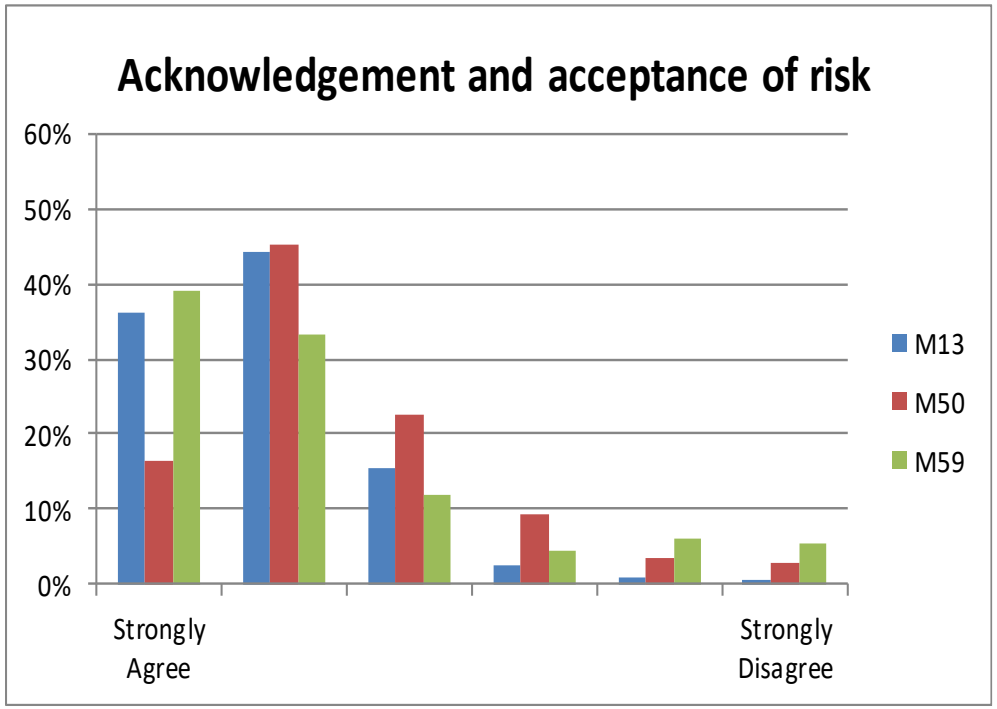
M13: *I fully consider the risks involved in the maintenance task prior to commencing the task.*

M50: *I apply risk strategies to the maintenance task as problems arise during the conduct of the task.*

M59: *My need to be creative in maintenance does not override the need to abide by the approved procedures.*

Innovative Utility

Tolerance and acceptance of risk



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However, what was evident from the Factor Analysis was that younger / less experienced tradespersons were making risk decisions and accepting risk outcomes without (perhaps) having sufficient technical knowledge or task proficiency to fully or completely understand the potential organisational or operational impact of such risk decisions.

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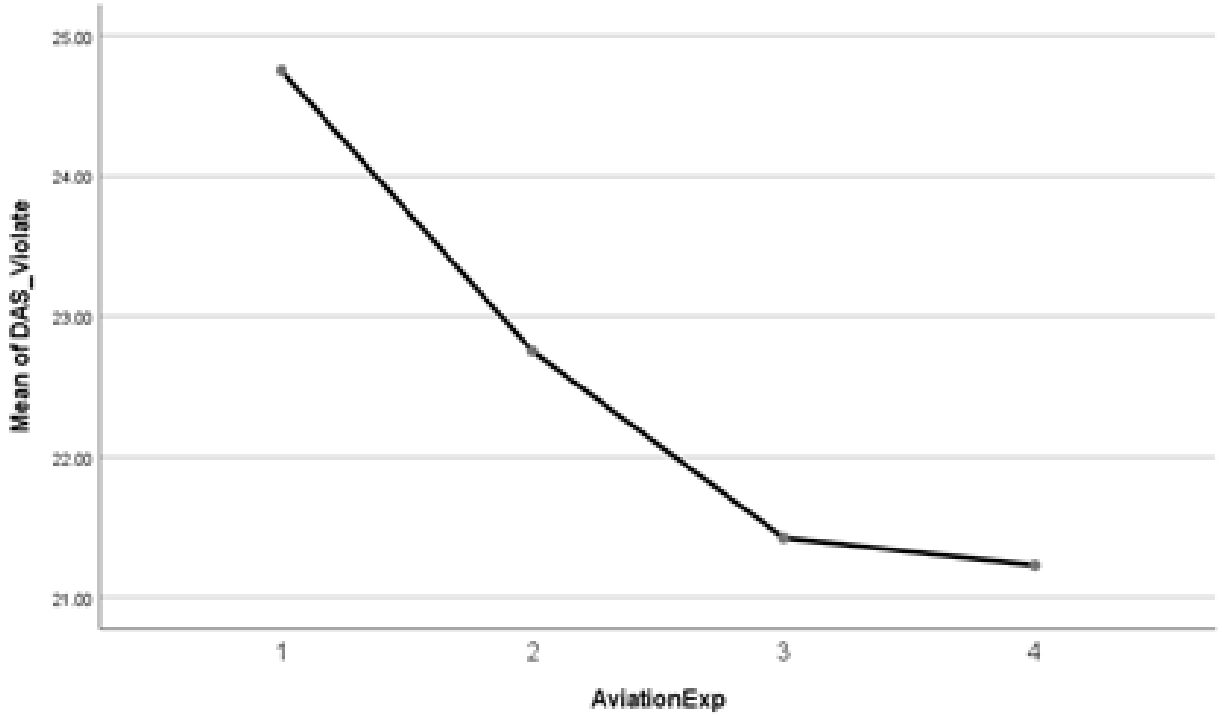
Aviation experience – violation acceptance



Decision Affect Schema (DAS) category of violation

Results indicate that more experienced participants were less inclined towards violation potential.

Conversely, less experienced participants scored higher in items specific to willingness to deviate from approved procedures.

Less experienced maintainers also scored higher in willingness to explore shortcuts when confronted by imposed obstacles.

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Maximise the benefits - Reduce rework – Minimise exposure to overt and latent risks

A substantial body of research exists to indicate that aviation maintenance personnel deviate.

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Maximise the benefits - Reduce rework – Minimise exposure to overt and latent risks

A substantial body of research exists to indicate that aviation maintenance personnel deviate.
Therefore:

- Actions go unrecorded and unreported
- Maintenance certifications are incomplete, inaccurate or fraudulent
- Risk decisions are made by individuals who may not have sufficient competency or authority to make such decisions
- Publication and procedure errors aren’t corrected - they are simply ignored
- Deviant behaviours become organisational norms
- Traceability of procedure deviance is non-existent

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There is a better way

Embedding a structured approach to positive deviance behaviours:

- improves aviation safety compliance,
- removes ineffective personal and organisational norms,
- provides clarity of risk exposure,
- ensures benefits from innovative decision-making are readily capitalised, thus,
- enabling the generation of performance, production and process improvements.

Innovative Utility

Maintenance Cost Reduction

Capture innovations:

- Maintenance personnel are deviating from publications and doing tasks a better way,
- Maintenance personnel are exercising technical judgements to achieve more effective or efficient ways of doing maintenance tasks without seeking or gaining approval
- Some innovations are deemed a safer way of doing the maintenance – however, such safer ways are not being reported nor shared

Innovative Utility

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Codify innovative actions:

- The maintenance organisation gets to identify and understand the risks its maintenance personnel are taking – this can only occur if the innovative actions are captured
- The maintenance organisation can assess the system criticality of each innovation
- The maintenance organisational sets the risk limits for innovative behaviours

Innovative Utility

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Control innovative behaviours:

- Authorise trusted and competent maintenance personnel within bounded risk tolerances
- Schedule and track publication and procedures amendments – conduct follow-up
- Routinely check which tasks have been innovated and ensure that appropriate risk controls are active

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That’s the big picture

Now let’s examine the detail

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Closing the breach between innovation and violation

- Constructing barriers to violation
- Innovative approaches to maintenance
- Innovation in aviation maintenance

Innovative Utility

Constructing barriers to violation

My research identified that positive deviance is actively practiced within the aviation maintenance domain and that extant governance and compliance barriers are ineffective in preventing decisions to innovate from becoming violations.

Build resistance to violations through:

- Implementing and supporting positive organisational norms
- Fostering and encouraging positive personal norms
- Generating efficacy of self-regulation towards compliant behaviours
- Ensuring technical personnel are empowered to act, exercise sound and effective judgement, and take accountability for their actions

Innovative Utility

Constructing barriers to violation

The effectiveness of barriers to innovative maintenance decisions is reliant on their structure, maintenance and upkeep and the willingness of individuals to accept the need for such barriers.

Therefore, understanding decision drivers of procedure deviance requires an appreciation of underlying motivations to proceed along an innovation pathway.

In defining innovative approaches to maintenance, it was necessary to understand whether participants were willing to innovate and what barriers exist to prevent innovations from becoming violations.

Belief in Organisational Norms		
M6	I have a full knowledge of the technical rules and airworthiness regulations applicable to my work.	81% (N=244)
M18	Adherence to rules and regulations is a key message from the organisation's management.	93% (N=278)
M24	When allocated a task I always plan my approach and gather the right tools and support equipment in adherence with the maintenance procedures.	96% (N=289)
M38	I feel it can be problematic to apply innovation to aviation maintenance tasks.	54% (N=161)

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Constructing barriers to violation

MIS 4: There are always better ways of doing a task that that described in the maintenance publications.

The other way of asking this question is:

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Constructing barriers to violation

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The other way of asking this question is:

Are you a dirty rotten violator?

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Constructing barriers to violation

MIS 4: There are always better ways of doing a task that that described in the maintenance publications.

The other way of asking this question is:

Are you a dirty rotten violator?

But that approach would certainly not get us any closer to the crux of the problem.

Deviation from maintenance publications (without relevant and applicable approval) is a violation.

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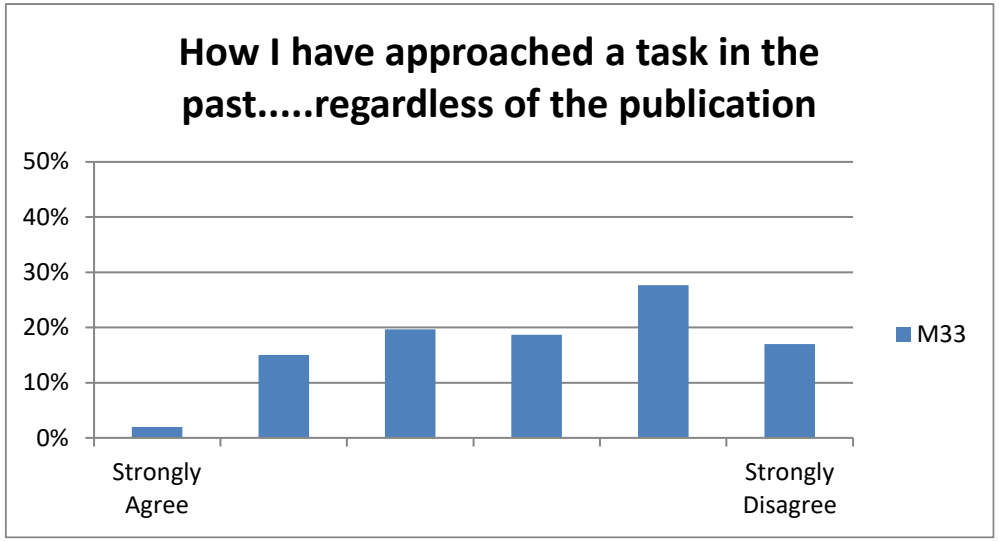
Constructing barriers to violation

Regulatory governance provides a foundation upon which full compliance with extant rules and requirements is expected, yet the findings presented in my thesis suggest that placement of obstacles and barriers to unapproved innovative maintenance actions are not difficult to defeat by those willingly deciding to deviate.



MIS 33: *How I have approached a maintenance task in the past strongly influences how I will approach it in the future regardless of the published procedure.*

Innovative Utility

Constructing barriers to violation

Utilisation of “aviation checklists, procedures and policies are driven to manage risks” (Maitre, 2015, p. 26) but, as my research revealed, expecting full compliance with published procedures is an ineffective barrier to either innovative or violation decisions.

Willingness to routinely operate at the limits of regulations and in defiance of approved procedures is not a new discovery but a continuance of behaviours previously identified (Castanier, Deroche & Woodman, 2013; Dahl & Olsen, 2013; Langer & Braithwaite, 2016; Morrow, McGonagle, Dove-Steinkamp, Walker, Marmet & Barnes-Farrell, 2010; Neitzel, Seixas, Harris & Camp, 2008; Tsagkas, Nathanael, & Marmaras, 2014).

Of concern, was evidence that risk acceptance by less experienced technicians with minimal on-type tenure—risks for which they have no authority to exercise—were being routinely taken. Adding to this concern were higher scores for seeking adventure, and greater willingness to pursue innovative maintenance practices.

Finding	Evidence
Improving task process or outcome	MIS responses and interview comments
Pressure to achieve task deadlines	MIS responses and interview responses
Desire to demonstrate technical mastery	Interview comments

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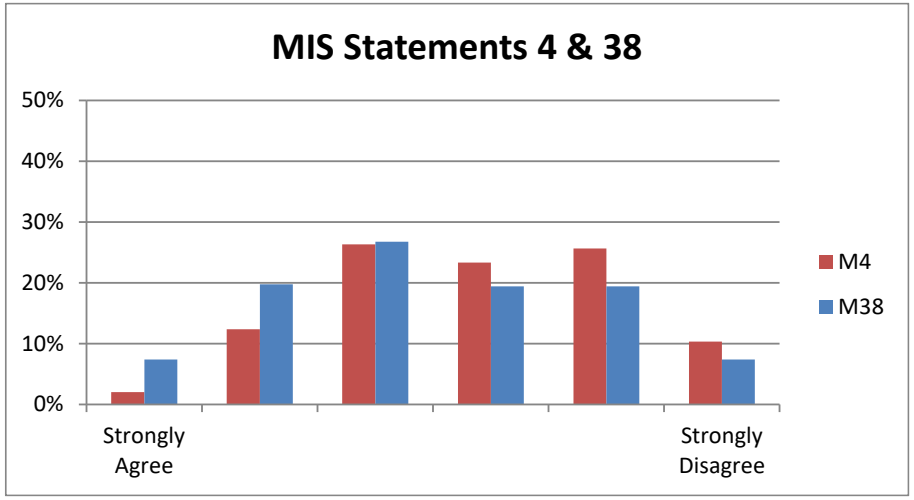
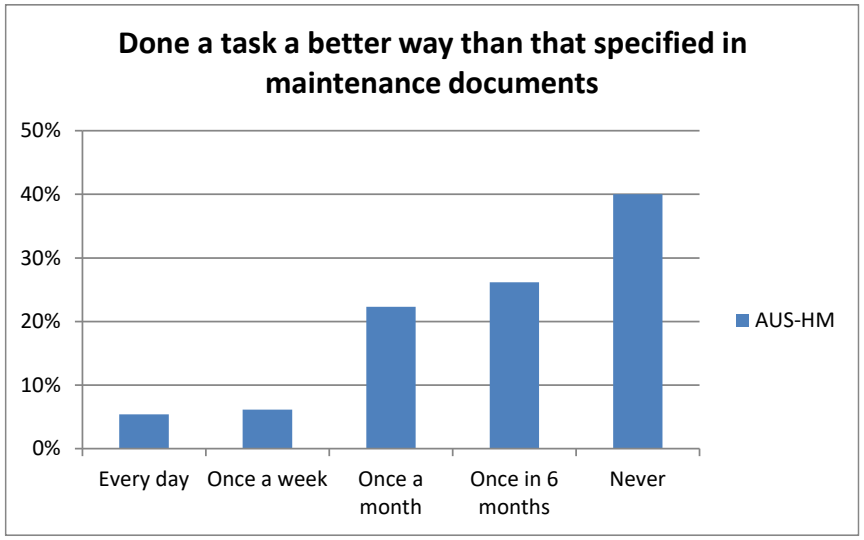
Innovative approaches to maintenance



MIS 4: *There are always better ways of doing a task than that described in the maintenance publications.*

MIS 38: *I feel it can be problematic to apply innovation to aviation maintenance tasks.*



MEQ data: *Australian aircraft heavy maintenance venue 2014 (130 participants).*

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Innovative approaches to maintenance

Multiple interviewees spoke about the need to rearrange or ignore process steps specified by approved publications or maintenance procedures.

Others spoke of doing a task a better way, of being more efficient. These, and others like them are deviations and indeed some are potentially violations.

In many instances the stated deviations were performed within teams, some were cited as being conducted under supervision.

Innovative Utility

Innovative approaches to maintenance

Multiple interviewees spoke about the need to rearrange or ignore process steps specified by approved publications or maintenance procedures.

Others spoke of doing a task a better way, of being more efficient. These, and others like them are deviations and indeed some are potentially violations.

In many instances the stated deviations were performed within teams, some were cited as being conducted under supervision.

The willingness of interviewees to discuss these events is to be applauded as such willingness demonstrates their enthusiasm for overcoming challenges (real or imagined) to achieve a task progression outcome.

Innovative Utility

Innovative approaches to maintenance

Innovating Task Performance or Outcome		
M4	There are always better ways of doing a task than that described in the maintenance publications.	41% (N=122)
M5	I am confident that the time spent in my current job allows me the flexibility to work independently of the maintenance procedures.	34% (N=102)
M9	My supervisor or manager encourages me to look for better ways to do maintenance tasks than those described in the maintenance publications.	44% (N=131)
M33	How I have approached a maintenance task in the past strongly influences how I will approach it in the future regardless of the published procedure.	37% (N=110)
M43	Poor scheduling of facility repairs and upgrades means maintenance shortcuts have to be taken.	22% (N=67)

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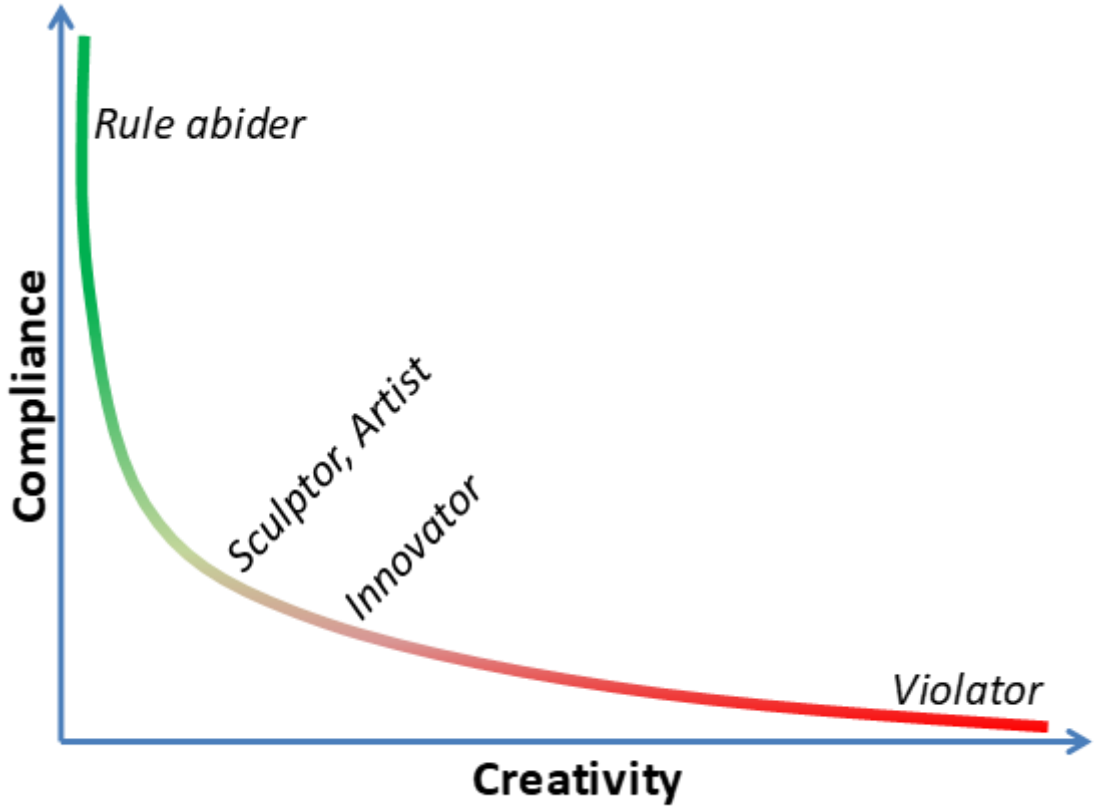
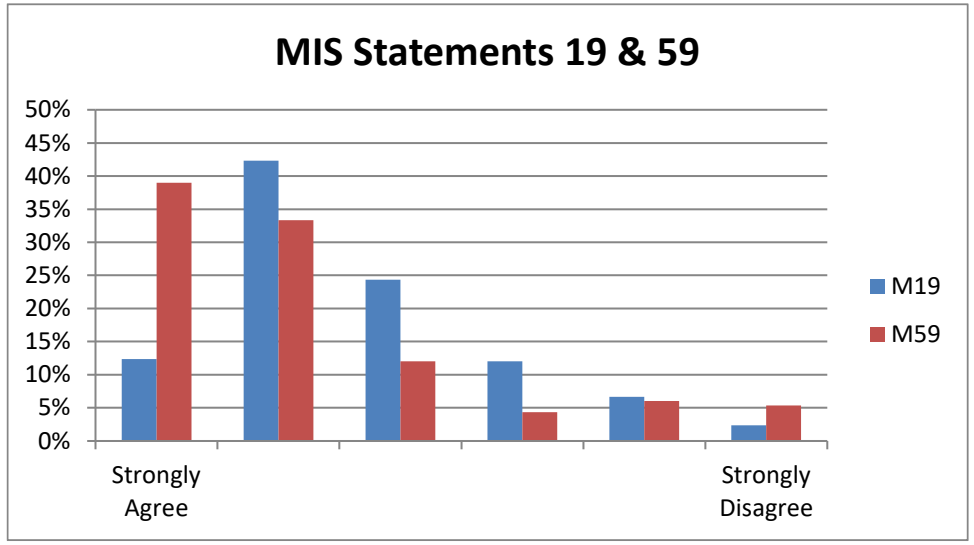
Innovative approaches to maintenance



Innovative Utility

Innovative approaches to maintenance



MIS 19: *I consider myself to be creative in my technical decision making.*

MIS 59: *My need to be creative in maintenance does not override the need to abide by the approved procedures.*

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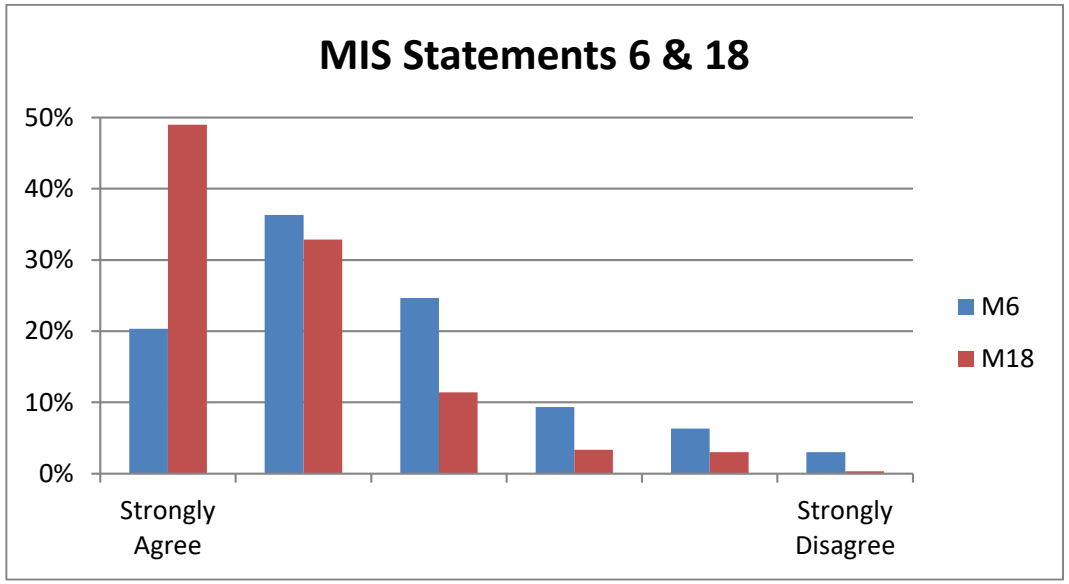
Innovation in aviation maintenance

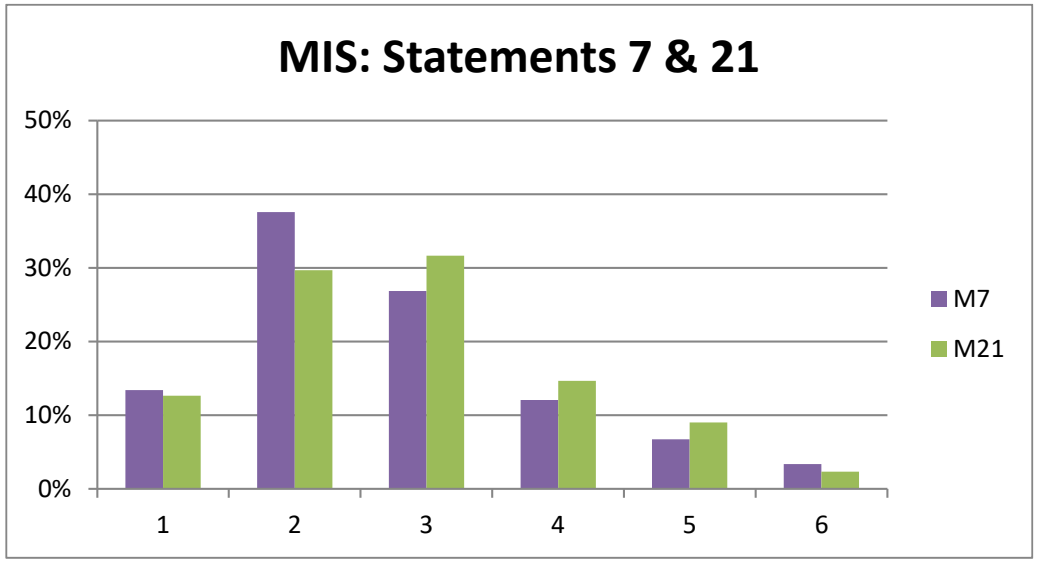


MIS 6: *I have full knowledge of the technical rules and airworthiness regulations applicable to my work.*

MIS 18: *Adherence to rules and regulations is a key message from the organisation's management.*

Innovative Utility

Innovation in aviation maintenance



MIS 7: *I feel that I am an innovative aircraft maintainer.*

MIS 21: *I feel that the organisation I work for values innovation.*

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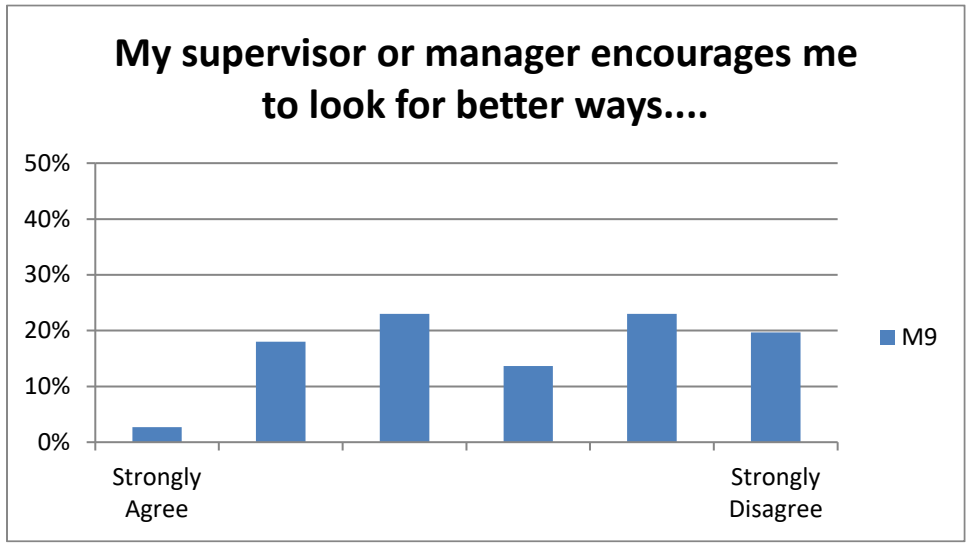
Innovation in aviation maintenance



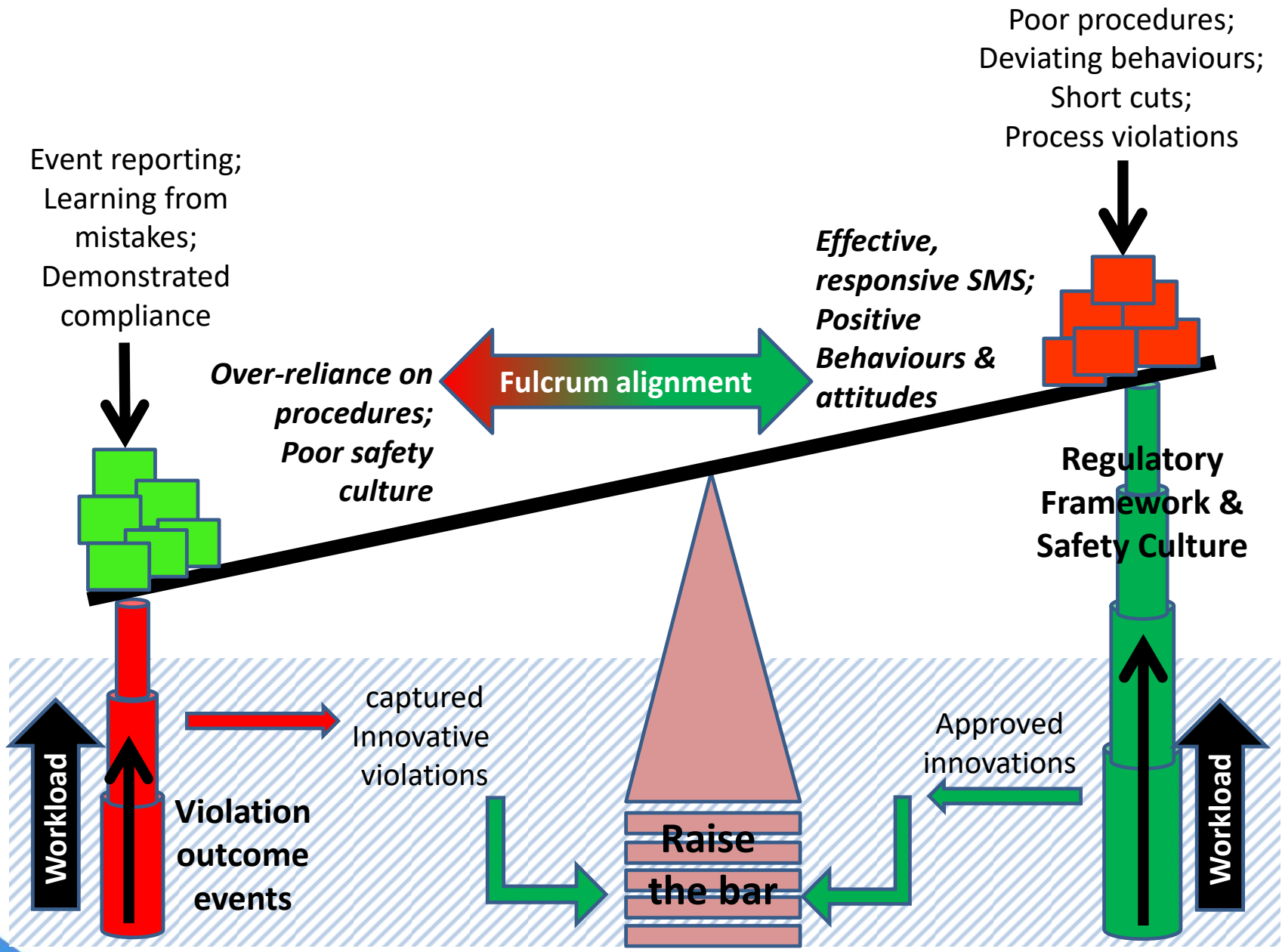
MIS 9: *My supervisor or manager encourages me to look for better ways to do maintenance tasks than those described in the maintenance publications.*

Innovative Utility

Enhancing Maintenance Safety Culture

- **Capture**: There is a high likelihood that procedure deviations are occurring – but go unrecorded and unreported.
- **Codify**: Ignoring small non-compliance behaviours fosters organisational and personal norms – that may lead to much larger and more detailed non-compliance outcomes.
- **Control**: Highly skilled and competent technicians want to be authorised to the full extent of their proficiency and professional acumen.

Innovative Utility



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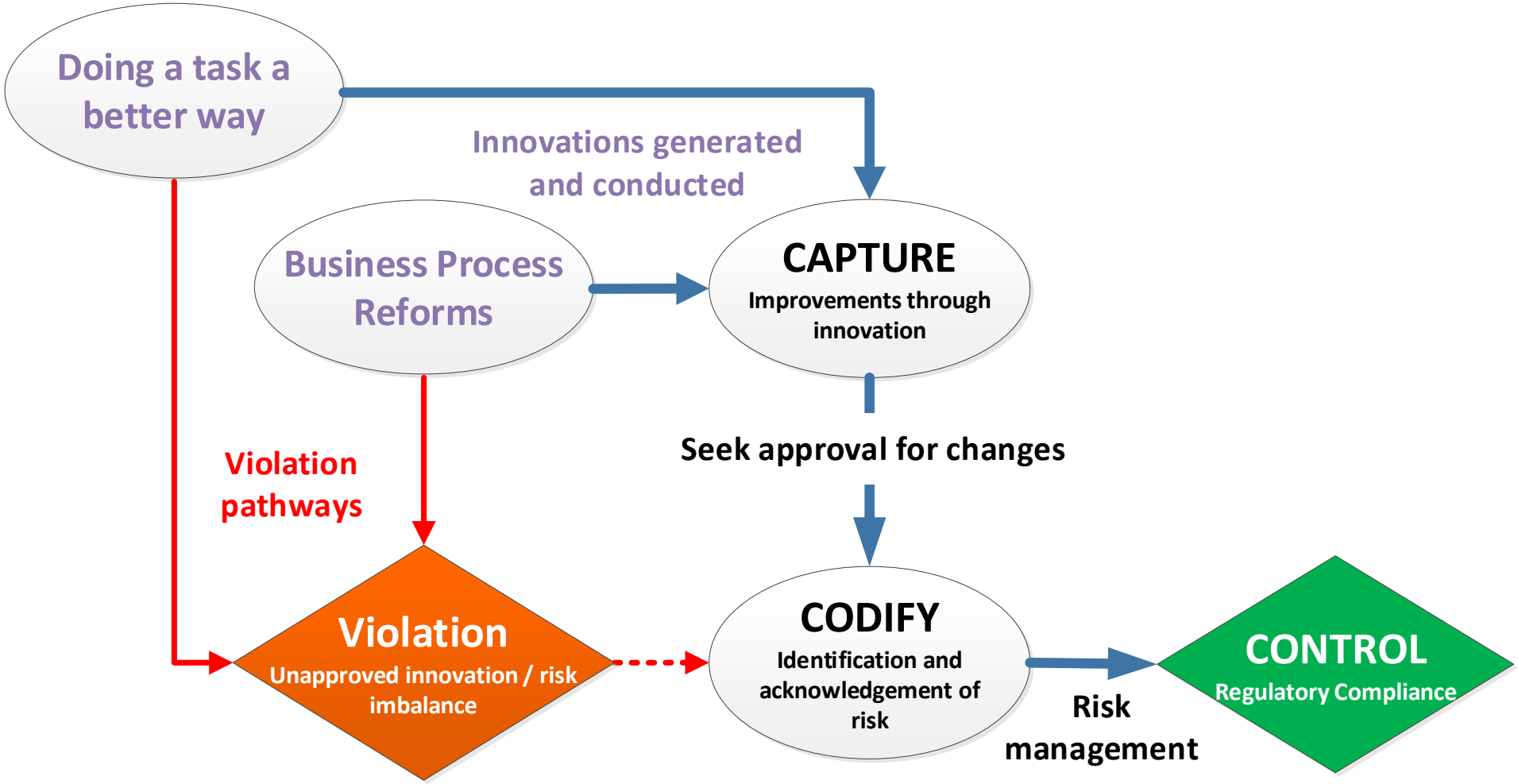
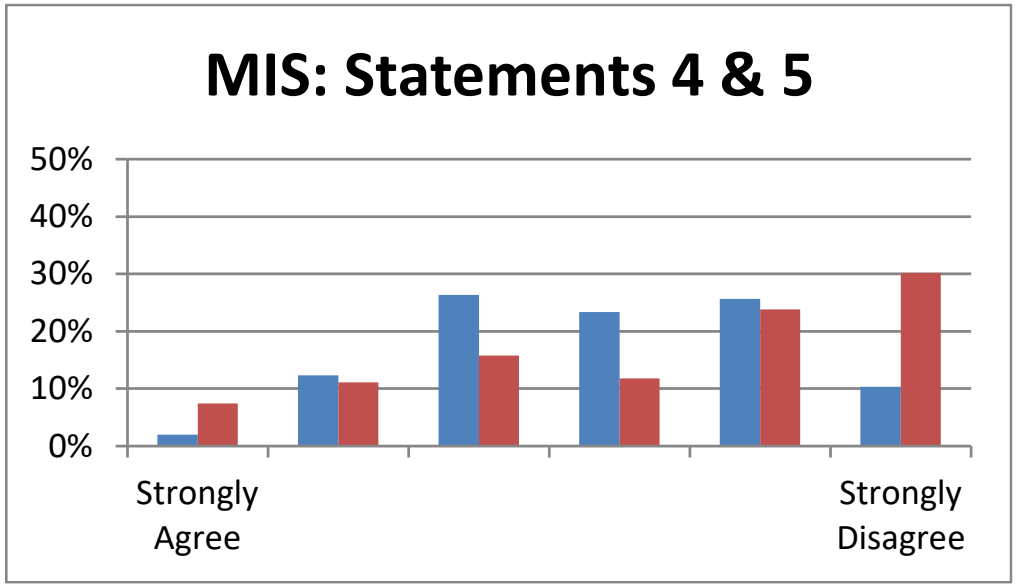


Innovative Utility

Capture

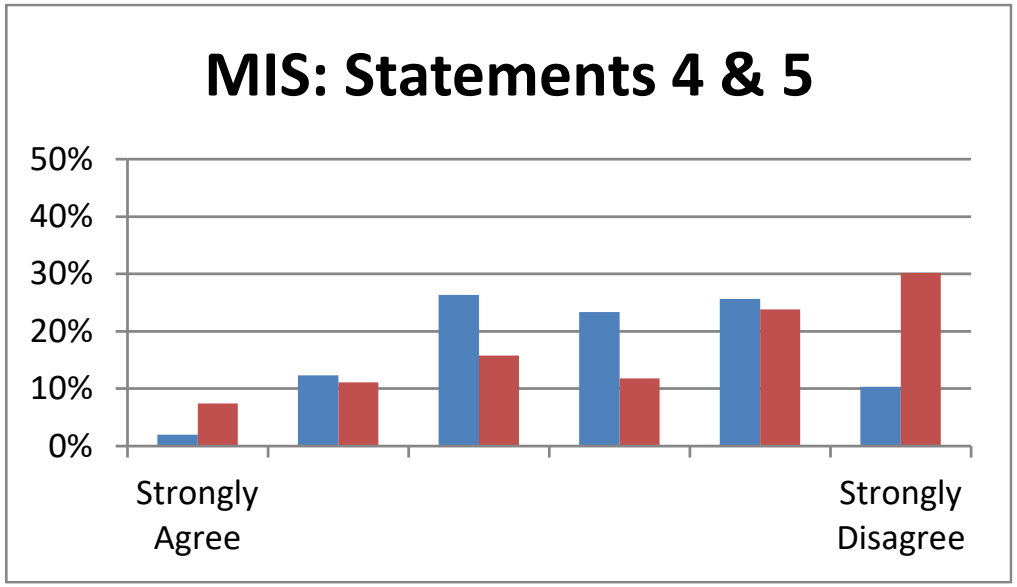


MIS 4: *There are always better ways of doing a task than that described in the maintenance publications.*

MIS 5: *I am confident that the time spent in my current job allows me the flexibility to work independently of the maintenance procedures.*

Innovative Utility

Capture



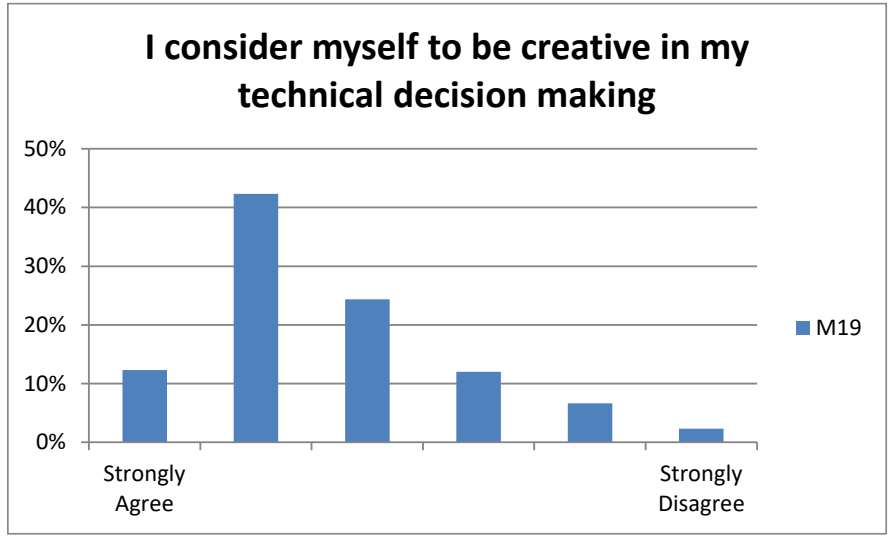
MIS 4: *There are always better ways of doing a task than that described in the maintenance publications.*

MIS 5: *I am confident that the time spent in my current job allows me the flexibility to work independently of the maintenance procedures.*

Such events have to be captured and recorded

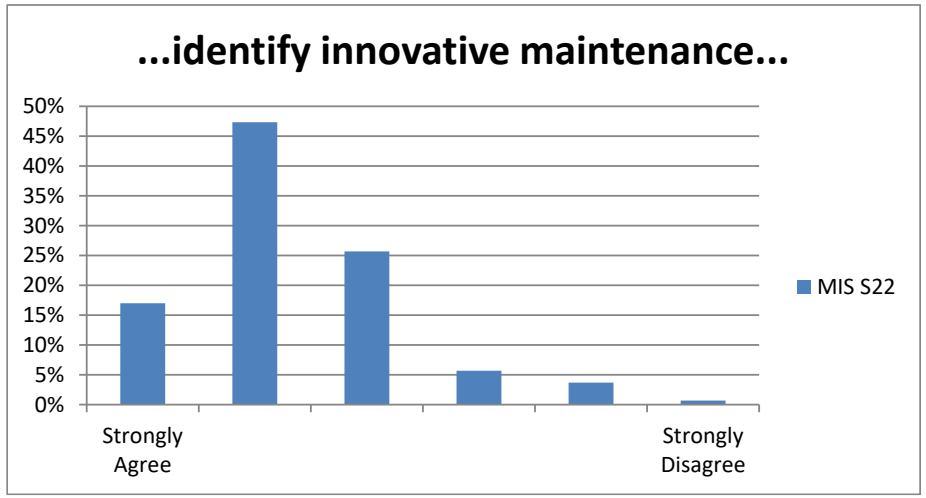
Innovative Utility

Capture



MIS 19: *I consider myself to be creative in my technical decision making.*

MIS 22: *I have a strong self-belief in my technical abilities which enables me to identify innovative maintenance solutions.*



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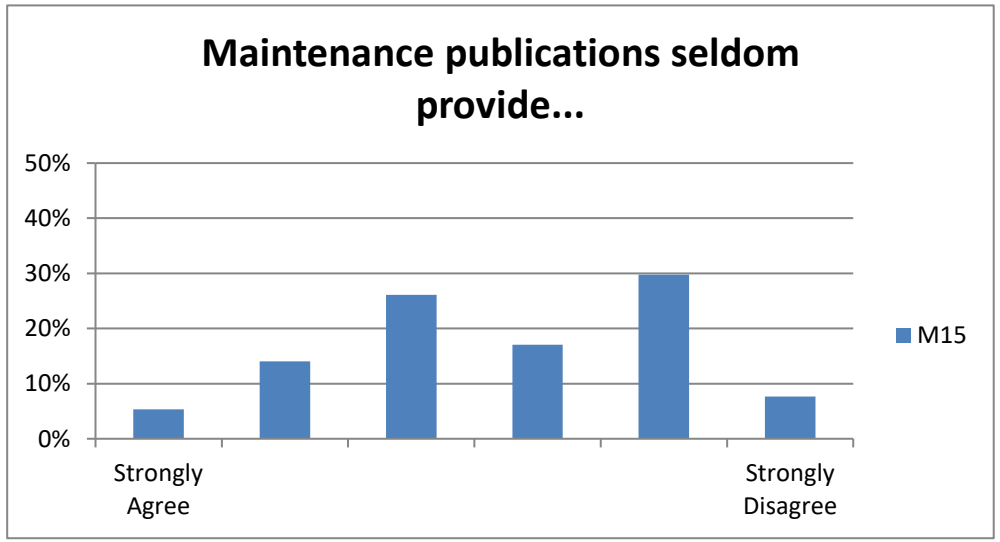
Codify

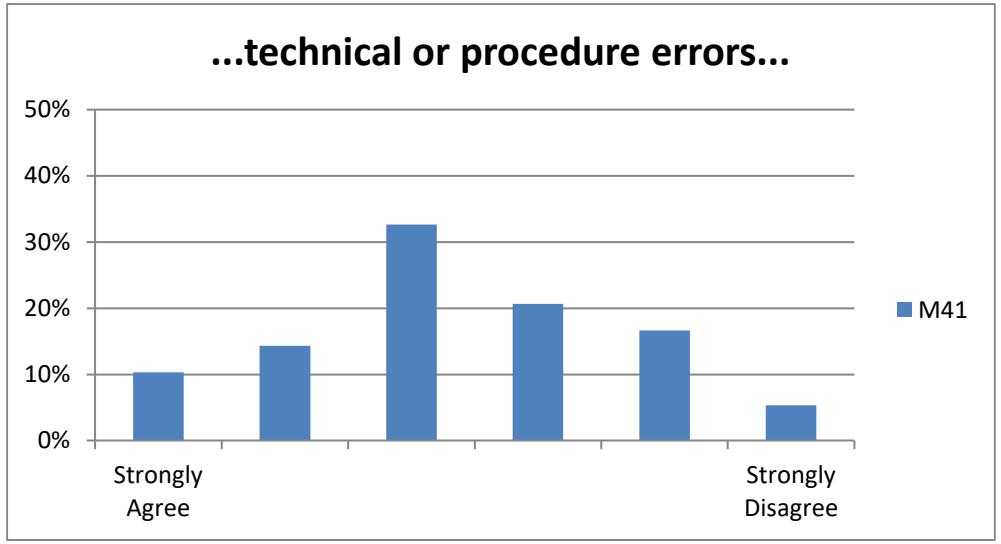
Ignoring small non-compliance behaviours fosters organisational and personal norms – that may lead to much larger and more detailed non-compliance outcomes.



MIS 15: *Maintenance publications seldom provide all the instructions required to complete complex tasks.*

Innovative Utility

Codify



MIS 41: *I routinely find technical or procedure errors in maintenance publications.*

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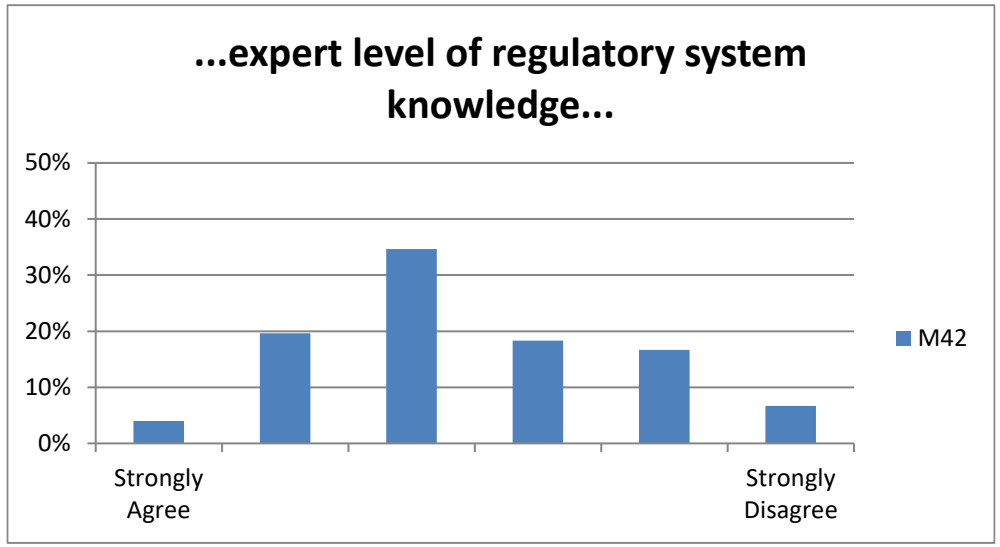
Codify



MIS 42: *I have an expert level of regulatory system knowledge and am able to apply that to improve maintenance outcomes.*

Innovative Utility

Control

Simply citing, and repeatedly restating, expectations and requirements for procedure compliance has not solved the problem of deviant decision making by maintenance personnel.

Extant research demonstrates that deviation from approved procedures has existed in the past and that it still exists.

Utilisation of the U_I equation provides a mechanism to regain control of positive deviance decision making, to generate improved behaviours, and to ensures visibility positive deviance behaviours and actions.

Innovative Utility

Control

$$U_I = \frac{S_C \, R_B}{I_A}$$

Where:

S_C = System Criticality

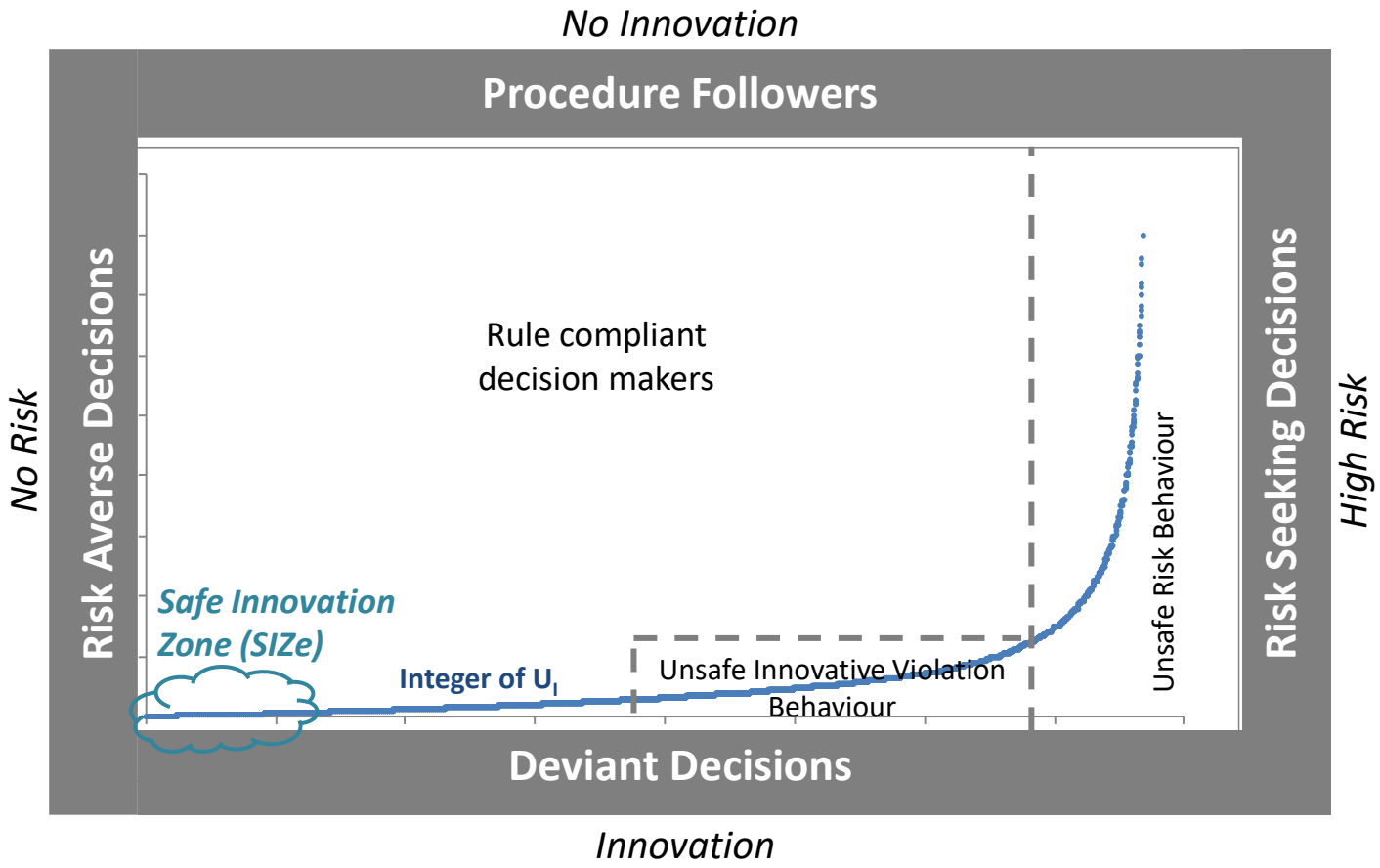
R_B = Risk Behaviour

I_A = Innovative Attitude

This equation is applicable to multiple domains and can be adapted for specific systems, behaviours and attitudes.

Innovative Utility

Control



The Safe Innovation Zone (SIZe) is given structure and purpose through application of the Utility of Innovation (U_I) equation. Defining the level of acceptable innovation then becomes a matter of assigning bounded U_I values.

Innovative Utility

Regain the advantage

Publication compliance alleviates the risk of a wrong action being taken; however, as evident from the current research, the proclivity of aviation maintenance personnel to willingly ignore specified publication requirements places greater emphasis on the need to capture creativity and innovation and prevent those actions and behaviours from traversing ineffective barriers to become violations.

Innovative Utility

Regain the advantage

Publication compliance alleviates the risk of a wrong action being taken; however, as evident from the current research, the proclivity of aviation maintenance personnel to willingly ignore specified publication requirements places greater emphasis on the need to capture creativity and innovation and prevent those actions and behaviours from traversing ineffective barriers to become violations.

Development of the Utility of Innovation model originated from identified gaps in the extant literature regarding innovation in practice, lack of a defined measurement of innovative intent, and evidence from the current study that existing innovative barriers were ineffective in preventing innovative maintenance activity and procedure deviances.

Innovative Utility

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Development of the Utility of Innovation model originated from identified gaps in the extant literature regarding innovation in practice, lack of a defined measurement of innovative intent, and evidence from the current study that existing innovative barriers were ineffective in preventing innovative maintenance activity and procedure deviances.

Furthermore, Technical and Regulatory Cohort interviewees commented on desires for their technical skills and demonstrated competency to be recognised through authorisation to innovate rather than having to seek external approval for even minor low risk innovations.

Innovative Utility

Implications for reducing Cost of Maintenance

There is potential to reduce maintenance costs and increase productivity.

Taking a systems safety approach to innovative violations – to reprise the topic of this presentation – is the catalyst for improved aviation safety outcomes.

Innovative Utility

Implications for reducing Cost of Maintenance

- Demonstrate organisational commitment to regulatory compliance
- Elevate your appreciation of the workforce's technical mastery
- Benefit from the investment you have made through training, upskilling and competency improvements
- Employ their skills, competencies and professional acumen to improve task outcomes
- Reduce resource wastage through sharing of innovative approaches to maintenance
- Improve safety compliance by demonstrating trust and managing innovative maintenance behaviours
- Invigorate your workforce to investigate and generate process, procedure, productivity improvements
- Take charge of regulatory compliance and aviation maintenance governance

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Implications for reducing Cost of Maintenance

We have an opportunity to regain the advantage for regulatory compliance and aviation maintenance governance by taking positive action to address positive deviance behaviours.

We can lead by taking a ***Capture Codify Control*** approach to innovative maintenance behaviours.

Innovative Utility

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Via the website:

www.innovativeutility.org

Link to my thesis:

Uncertain outcomes: Traversing the breach between innovation and violation in aviation maintenance

https://nova.newcastle.edu.au/vital/access/manager/Repository/uon:37484

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