



Australian Government
Department of Defence
Defence Aviation Safety Program

10 WAYS TO BETTER AVIATION REGULATION



ASSURING SAFETY
OF DEFENCE AVIATION

- 1. Employ Hazard-Based Regulation**
Ensure regulatory obligations are only imposed to treat threats to aviation safety.
- 2. Maximise Outcome-Based Regulation**
Where possible, focus regulation on the outcomes needed to treat threats to safety and not the means of achieving those outcomes.
- 3. Take a Purposive Approach**
Express the purpose of the regulatory obligation simply and clearly and interpret and apply regulation with its purpose at the forefront of mind.
- 4. Utilise Compliance Proofs**
Define verification criteria against which to assess compliance.
- 5. Ensure Sufficient Prescription**
Decompose outcomes into constituent parts so that obligations are comprehensively specified and ambiguous principles are avoided.
- 6. Provide Comprehensive Explanation**
Implement a comprehensive and ongoing education program on aviation safety regulation.
- 7. Utilise Safety Indicators**
Utilise a wide-range of indicators to understand safety performance and drive continuous improvement.
- 8. Apply Risk-Based Oversight**
Use a robust risk-based assessment process to allocate finite oversight resources most effectively.
- 9. Take a Graduated Response**
Escalate enforcement remedies to elicit acceptable and compliant behaviour proportional to the observed behaviour and intent of the regulated entity.
- 10. Establish Genuine Engagement**
Aim to develop mutual respect, appreciating the natural tension between regulators and the regulated community.



Australian Government
Department of Defence
Defence Aviation Safety Program

10 Ways to Better Aviation Regulation

Assuring Safety of Defence Aviation

A stylized, handwritten signature in black ink, consisting of several overlapping strokes.

Air Marshal Leo Davies, AO CSC
Defence Aviation Authority

Air Force Headquarters
Canberra

January 2016



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10 WAYS TO BETTER AVIATION REGULATION FOREWORD

Defence is responsible for self-regulation of its aviation practices and regulation of its industry suppliers through implementation of the Defence Aviation Safety Program (DASP). The DASP is an adaptation, with due consideration to the Defence environment and Commonwealth Legislation, of the International Civil Aviation Organisation (ICAO) State Safety Programme (SSP) standard.

In implementing the DASP, and aligning with government expectations, aviation safety regulation should aim to minimise unnecessary costs on Defence and industry while achieving the requisite safety outcomes.

There are many facets to achieving this objective. One involves defining and articulating the principles upon which our regulatory behaviour is based. Such is the aim of this publication. But rather than dogma for automatic response, *10 Ways to Better Aviation Regulation* aims to promulgate guidance for intelligent application by regulatory staff. The goal for you the reader is to guide you in the application of these principles in practice. In doing so you will be supporting improved safety regulation of Defence aviation.

Air Marshal Leo Davies, AO CSC
Defence Aviation Authority





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10 WAYS TO BETTER AVIATION REGULATION UNDERSTANDING THIS PUBLICATION

Experience without theory is blind, but theory without experience is mere intellectual play.¹

RATIONALE OF THE WORK

Regulating is a discipline in its own right. Analysis of regulation has become a theoretical exercise over the past three decades. Regulating for safety, environmental protection and tax administration to name a few have much more in common than practitioners often realise. This means there is a wide variety of sources available for us to benefit from, some theoretical, some more practical.

10 Ways to Better Aviation Regulation communicates our best understanding of the principles to achieve more effective and efficient regulation of Defence aviation. The work was developed following a significant period of investigation and research by Defence aviation regulators. This publication aims to build on the existing body of knowledge including:

- The *Australian Government Guide to Regulation* directs regulation-makers to always question its need and address its impact early in the regulation-making process.²
- The Organisation for Economic Co-operation and Development (OECD), of which Australia is a member, provides seven guiding principles for regulatory quality and performance.³
- The Australian National Audit Office (ANAO) describes a framework to assist regulators in assessing the quality of their administrative practices and areas of improvement.⁴

This publication does not set out to replace, or be in conflict with, any of these publications. It aims to complement them specifically for Defence aviation by:

- (i) Providing more relevance – achieved by interpretation within the context of safety-related aviation regulation; and

¹ Immanuel Kant (1724-1804).

² Australian Government (2014) *Australian Government Guide to Regulation*.

³ Organisation for Economic Co-operation and Development (2005) *OECD Guiding Principles for Regulation Quality and Performance*.

⁴ Australian National Audit Office (2007) *Administering Regulation: Better Practice Guide*.



- (ii) Ensuring practicality – grounded by twenty years of real regulatory practice in Defence.

Throughout this publication you will find reference to many good sources of information including the Productivity Commission and various Australian governments. A dash of academic theory is included from sources including the Australian National University's Regulatory Institutions Network (RegNet), Harvard University's Kennedy School of Government and others.

Aviation context is added through reference to authorities including, in no particular order, the United States Federal Aviation Administration (FAA), European Aviation Safety Agency (EASA), the Australian Civil Aviation Safety Authority (CASA), the European Defence Agency (EDA), the United Kingdom Military Aviation Authority (MAA) and the International Civil Aviation Organisation (ICAO).

Lastly practical examples from Australian Defence were provided by regulatory staff.

TARGET AUDIENCE

10 Ways to Better Aviation Regulation is aimed at regulatory staff. It focuses on principles and practice, and is more to do with advancing behaviours rather than changing regulation. The goal for you the reader is to apply these principles in practice. In doing so you will be supporting improved regulation of Defence aviation.

A FOCUS ON REGULATORY PRACTICE

10 Ways to Better Aviation Regulation supports regulatory reform. But the term regulatory reform means different things to different people so it is worth explaining which aspects are addressed and which are not. Regulatory reform can be neatly grouped into any of the following subject areas:⁵

- **Scope of regulation.** Deregulation (removing) and re-regulation (replacing) of existing regulation, and regulation of emergent issues (new regulation).
- **Nature of regulation.** Implementing alternative forms of regulation, such as the use of self regulation, voluntary compliance schemes and so on.
- **Locus of regulation.** Altering the balance of centralisation versus decentralisation, such as levels of regional or local autonomy and the relationship between different regulators.
- **Behaviour of regulators.** The strategies, tactics, operational methods and culture of regulatory agencies.

This publication focuses on the behaviour of regulators. Whatever improvement is made to the scope, nature or locus of regulation, it falls to regulatory staff for implementation. The style and nature of implementation, in other words the behaviour of regulators, can make or break reform.

⁵ Attributed to Cary Coglianese of the Kennedy School of Government in Sparrow, M (2000) *The Regulatory Craft: Controlling Risks, Solving Problems, and Managing Compliance*, the Brookings Institution Press, pp 3.



STRUCTURE

This publication explains the ten most important behavioural principles to achieve better Defence aviation safety regulation. Whilst the narrative of this publication is continuous each chapter is largely self-contained and may be read in isolation. The structure is as follows:

- Regulating – an Introduction
- Chapter 1 – Employ Hazard-Based Regulation
- Chapter 2 – Maximise Outcome-Based Regulation
- Chapter 3 – Take a Purposive Approach
- Chapter 4 – Utilise Compliance Proofs
- Chapter 5 – Ensure Sufficient Prescription
- Chapter 6 – Provide Comprehensive Explanation
- Chapter 7 – Utilise Safety Indicators
- Chapter 8 – Apply Risk-Based Oversight
- Chapter 9 – Take a Graduated Response
- Chapter 10 – Establish Genuine Engagement

Those familiar with regulatory policy know it is important to bridge the gap between theory and practice. So after commencing with a summary each chapter consists of three forms of content:

- In-Theory.** Consisting of a summary of relevant regulatory theory. Most useful to readers who prefer to develop a deeper understanding by focussing on the 'why'.
- In-Context.** Here the regulatory theory is translated into language more readily applied to Defence aviation safety regulation.
- In-Practice.** Examples of snapshots of time in the past, relating the principles with real examples from Defence. In-practice examples appear as breakout boxes.

CHAPTER OUTLINE

REGULATING – AN INTRODUCTION

The safety authority is a unique organisation, neither delivering products nor services in the traditional sense. Rather the aim of a safety authority is to deliver safety assurance within complex environments involving many stakeholders. This is the basis of the introductory chapter *Regulating – an Introduction*. Given the decision to regulate, which is but one means of a safety authority, we introduce the three activities involved in regulation: to **regulate**, to conduct **oversight** and to conduct **enforcement**.



Secondly, the importance of a regulator and its separation from those it regulates should be recognised. The primary reason is to ensure that judgements can be made, and enforcement actions taken, without pressure from interests that may conflict with the regulator's primacy on safety. This is referred to as regulatory **independence**. The credibility of the regulator's authority, particularly in non-legislatively backed regimes, depends in part upon whether the authority is regarded as an independent decision maker.

Thirdly, a safety authority never delivers safety assurance alone. Consideration is given to the many stakeholders in the regulatory process, in addition to those regulated, who may be relied upon by the safety authority. Regulation never starts with a clean sheet after all; the space is often already full of regulation. Regulators need to be aware of this and exploit it. This is referred to as **recognition**.

Finally, the chapter concludes by describing a **regulatory model** to aid understanding of the ten principles subject of this publication.

CHAPTER 1 – EMPLOY HAZARD-BASED REGULATION

Hazard-based regulation means ensuring regulatory obligations are only imposed to treat threats to aviation safety. The rationale behind hazard-based regulation is that it focuses the attention of all those involved in the regulatory process on aviation safety and reduces regulatory burden by avoiding non-safety related regulation. Hazard-based regulation is achieved by using a risk model to analyse hazards that may materialise and prescribing regulations and standards to assure safety.

CHAPTER 2 – MAXIMISE OUTCOME-BASED REGULATION

Maximising **outcome-based** regulation means, where possible, focussing regulation on the outcomes needed to treat threats to safety and not the means of achieving those outcomes. Outcome-based regulation is a style that allows for a range of acceptable solutions rather than imposing or presuming single means of compliance. The result is flexibility for the regulated community to develop and implement solutions while achieving the same level of safety assurance.

CHAPTER 3 – TAKE A PURPOSIVE APPROACH

Purposive regulation means expressing the purpose of the regulatory obligation simply and clearly and interpreting and applying regulation with its purpose at the foremost of mind. The benefit of purposive approach is that it increases clarity as to the purpose of the regulation, thereby protecting against tactical, 'black and white' or nonsensical interpretation disputes between members of the regulated community and the regulator.

CHAPTER 4 – UTILISE COMPLIANCE PROOFS

Compliance proofs are verification criteria against which to assess compliance. Compliance proofs define specific, measurable, demonstrable and repeatable verification requirements for each



regulation to support unambiguous compliance determination. The benefit of compliance proofs is certainty as to the compliance requirements, thereby minimising compliance disputes and unnecessary 'gold plating'.

CHAPTER 5 – ENSURE SUFFICIENT PRESCRIPTION

Sufficient prescription means decomposing outcomes and compliance proofs into sub-outcomes and sub-proofs so that obligations are comprehensively specified. Such prescription ensures clarity and certainty of outcome-based regulation and avoids high-level and ambiguous principles.

CHAPTER 6 – PROVIDE COMPREHENSIVE EXPLANATION

Implement a comprehensive and ongoing education program on aviation safety regulation. **Comprehensive explanation** supports consistent interpretation and application of regulation by all stakeholders in the regulatory process, protecting against conservative application inherent with poor understanding of regulation.

CHAPTER 7 – UTILISE SAFETY INDICATORS

For continuous monitoring and assessment of safety performance, the regulator should utilise a wide-range of **safety indicators** to understand safety performance and drive continuous improvement.

CHAPTER 8 – APPLY RISK-BASED OVERSIGHT

To best utilise finite resources apply a robust **risk-based** assessment process to allocate oversight resources most effectively. This means treating each member of the regulated community differently based on management of the risks of noncompliance. The result is improved utilisation of scarce resources by focussing resources according to risk.

CHAPTER 9 – TAKE A GRADUATED RESPONSE

Ensure enforcement action is fair by escalating remedies to elicit acceptable and compliant behaviour proportional to the observed behaviour and intent of the regulated entity. **Graduated response** incentivises generative safety culture within members of the regulated community rather than severely penalising minor infractions to the detriment of honest reporting.

CHAPTER 10 – ESTABLISH GENUINE ENGAGEMENT

Appreciating the natural tension between regulators and the regulated community, aim to develop mutual respect through **genuine engagement** using formal and informal approaches.





10 WAYS TO BETTER AVIATION REGULATION REGULATING – AN INTRODUCTION

WHY REGULATE?

Social and informal mechanisms are basic modes of regulating behaviour. In a social context behaviour is often regulated by personally asking someone to do (or not do) something. But when these mechanisms prove inadequate, and the outcome results in negative effects on a community-wide scale, someone or something is sought to act on behalf of individuals for the greater good.

When a government or some other empowered body makes a decision to regulate they seek to bring about a social state better than without regulation. They do this by placing obligations on individuals and organisations. Examples of where regulation is common include preventing market failures, threatening of public confidence or harm to people, property or the environment.

WHAT IS REGULATION?

Regulation has no single definition. Some definitions are broad, capturing mechanisms of social control or influence which may not explicitly be written. Some are much narrower, such as legal-system definitions focused on legislation.

In this publication regulation refers to the diverse set of instruments used by government and other authorities to influence or control the way people and organisations behave where there is at least a reasonable expectation of compliance. It consists of 3 broad functions:

1. Developing, enacting and refining regulations promulgated via a regulatory instrument placing obligations on the appropriate recipients to achieve the regulatory objective;
2. Verifying compliance with such regulations; and
3. In the event of departure from those obligations by those under regulatory oversight, enforcing the established regulations by imposing appropriate corrective measures.

In short:

Regulation is any rule endorsed by government where there is an expectation of compliance.⁶

⁶ Australian Government (2014) *Australian Government Guide to Regulation*, Canberra.

INSTRUMENTS OF REGULATION

Regulation is enacted through a regulatory instrument. Instruments of regulation can be broadly categorised along a continuum of government intervention, ranging from legislation to self regulation as shown in Figure 1. Each form has advantages and disadvantages. The intention of this publication is to inform the reader of the various forms of regulation, but not to compare them.⁷

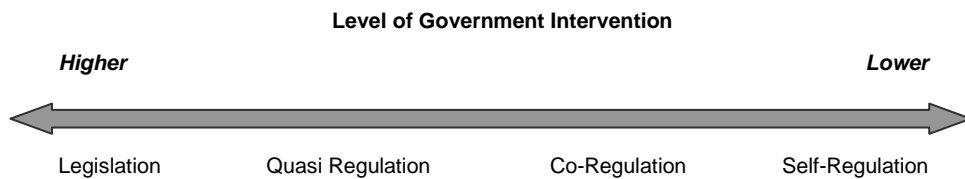


Figure 1. The continuum of government control by regulatory instrument.

Primary legislation is law made by a State or Federal Parliament. An example is the *Corporations Act 2001* (Cth) which is an act of the Commonwealth of Australia that sets out the laws dealing with business entities in Australia at federal and interstate level.

Delegated Legislation is law made by an authority to which Parliament has delegated part of its legislative power in order to administer the requirements of the primary legislation. For example in Australian civil aviation the federal Department of Infrastructure and Regional Development, the Civil Aviation Safety Authority (CASA) and Airservices Australia administer delegated legislation under powers given to them in the *Civil Aviation Act 1988*. An example instrument of delegated legislation administered by CASA is the *Civil Aviation Safety Regulations (CASR) 1998*.

Quasi Regulation encompasses those rules, instruments and standards by which government influences business to comply, but which do not form part of explicit government legislation. Examples can include government endorsed industry codes of practice or standards, government issued guidance notes, industry-government agreements and national accreditation schemes. An example is the agreement between Telstra, Optus and Primus to voluntarily filter a list of websites known to contain material relating to child abuse. The list is compiled and maintained by the Australian Communications and Media Authority (ACMA).

Co-Regulation (or Enforced Self Regulation) is a hybrid in which industry develops and administers particular codes, standards or rules, but the government provides formal legislative backing to enable the arrangements to be enforced. Regulation of radio and television content is co-regulatory. In this example industry groups develop codes under the *Broadcasting Services Act 1992* (Cth), in consultation with the ACMA. Most aspects of program content are governed by these codes, which

⁷ For further information on the various instruments see Australian Government (2007) *Best Practice Regulation Handbook*, Canberra, appx A.



include the Commercial Television Industry Code of Practice and the Commercial Radio Australia Code of Practice and Guidelines. Once implemented, the ACMA monitors these codes and deals with unresolved complaints made under them.

Self Regulation is an arrangement in which an organised group (such as an industry association) regulates the behaviour of its members. For example, the content of advertising is subject to a self-regulatory system created by the Australian Association of National Advertisers (AANA). The AANA manages a Code of Ethics and the Advertising Standards Bureau (ASB) incorporates an independent Advertising Standards Board to hear complaints regarding advertising content.

Box 1: In-practice – instruments of Defence aviation safety regulation

The Defence aviation safety regulations are a system of self regulation and quasi regulation with the aim of ensuring Defence aviation is conducted at acceptable level of risk of harm to personnel or property. Whilst the regulations are all promulgated in the same suite of documents the type of regulatory instrument according to the previous definitions is determined by the two target groups comprising the regulated community.

DEFENCE UNITS AND PERSONNEL

Defence is **self regulating** under the authority of the Defence Aviation Authority (DAA). The authority of the DAA to regulate Defence and its personnel stems from:

- (i) Chief of Defence Force as a general order to Defence members under the *Defence Force Disciplinary Act 1982*, and
- (ii) Secretary of the Department of Defence as a lawful and reasonable direction to Defence employees under the *Public Service Act 1999*.

Noncompliance with the aviation regulations could lead to disciplinary action of the responsible individual under the applicable Act.

COMMERCIAL ORGANISATIONS AND STAFF

Defence is **quasi regulating** under the authority of the DAA. The authority of the DAA to regulate commercial organisations stems from a contract between each commercial organisation and the Commonwealth of Australia which includes scope to comply with the Defence aviation safety regulations.

Noncompliance with the regulations could constitute a breach of contract and lead to remedies under contract law. The regulations are not applicable to sub-contractors unless a suitable contractual arrangement exists.



SAFETY REGULATION

In any human endeavour involving a complex system such as aviation, a lack of safety comes about because those involved fail in acting with the required diligence, or because they were unable to see or influence existing or emerging threats. Furthermore organisational and environmental influences contribute to latent conditions that can subvert or bypass existing controls.

Safety regulation aims to correct this to assure the most important controls are not reduced or subverted. Too little safety is clearly a bad thing and is unacceptable. Improving safety by constraining the 'unsafe' activity may also be unacceptable as it may prevent the desired outcome (which presumably is of benefit otherwise it would not have been attempted in the first instance). Safety regulation is correctly targeted when it achieves the required level of safety, and no more.

ROLE OF AN AVIATION SAFETY AUTHORITY

In civil aviation, the promotion of safety is the underlying philosophy of all aviation regulation across the world. The Convention on International Civil Aviation was signed in Chicago in 1944, and it created the International Civil Aviation Organisation (ICAO), which in 1947 became a specialised Organisation of the United Nations. The Convention focuses on international civil aviation.⁸

ICAO requires member states, Australia included, to establish civil airworthiness organisations who should manage regulations, policy and guidance, conduct surveillance, investigations and enforcement, staffing and training.⁹ In developing regulations the regulator has the option of adopting provisions which will govern its role in the implementation of the regulations. This may range from highly active to passive.

In the active role, a close day to day interest would be taken in the direction and control of all airworthiness matters through an inspection organisation. This could be so rigorous as to dominate and dictate conduct of all airworthiness activities leading to undermined personnel, lowered safety and increased cost, and confusion regarding who is responsible for actions.

In the passive role the regulator would intervene only to institute action when a violation of the regulations has occurred. The regulator could leave interpretation and implementation of the regulations up to those regulated, relying upon their competence to interpret correctly and encouraging compliance through threat of enforcement only.

In practice neither is solely compatible with equitable and effective division of responsibility between regulators and regulated. The ICAO position is that considerable merit exists for a regulatory system which has elements of both extremes, and will:

⁸ While focussing only on international civil aviation, ICAO's role overseeing the majority of the world's aviation regulators, its wealth of publically available information and lack of a military equivalent leads it as an obvious reference.

⁹ For further information see ICAO (2014) *Airworthiness Manual* Doc 9760 3rd edn.



- (i) Represent a well balanced allocation of responsibility between the State and those persons or organisations conducting airworthiness-related activities;¹⁰
- (ii) Be capable of economic justification within the resources of the State;
- (iii) Enable the State to maintain continuing regulation and supervision of the airworthiness activities of the operator, manufacturer and maintenance facility without unduly inhibiting their effective direction and control of their organisations; and
- (iv) Result in the cultivation and maintenance of harmonious relationships between the State and those persons/organisations applying regulations in practice.

These characteristics are just as applicable to military aviation.

Box 2: In-practice – objective of Defence aviation safety regulation

Defence requires capability that delivers a required operational outcome in a nominated environment, within a specified time, and the ability to sustain that effect for a designated period. Central to this capability is the safe operation of airworthy aircraft.¹¹

While Defence aviation is explicitly excluded from Australian civil aviation legislation Defence chooses to regulate organisations and people involved in Defence aviation with the aim of safety, acknowledging that the required operational outcomes must be weighed against the potential for harm to people and/or property. Preventing market failures or other public policies often the subject of regulation, such as ensuring appropriate expenditure of Commonwealth funds, is not within the mandate of the Defence aviation safety regulations.

Within the regulatory system, the role of Defence aviation safety regulators is to **assure** safety, which means to achieve confidence and reassurance by monitoring and reporting on those responsible for safety. The role of the regulator is not to **ensure** everything is safe by either doing all the work themselves, or checking that it is done the way they would have done it. The regulator is not 100% responsible for all actions taken by those regulated.¹²

¹⁰ Here *State* refers to ICAO contracting states – countries who are signatories to the Convention on International Civil Aviation (the Chicago Convention).

¹¹ Defence Instruction (General) OPS 02-2 *Defence Aviation Safety Program*.

¹² To *assure* is to give confidence or to reassure, by monitoring. To *ensure* is to make happen.



INDEPENDENCE AND RECOGNITION

INDEPENDENCE OF REGULATORY AUTHORITIES

*There must be thorough independence throughout the regulatory regime, in particular in the setting of safety and airworthiness policy, regulation, auditing and enforcement.*¹³

Human behaviour in any work system is shaped by objectives and bounded by financial, resource and safety constraints (in addition to ethical and moral issues). Breach of any of these boundaries is undesirable. Whether defending the country or earning a profit, organisations with an objective (military or civilian, government or commercial) will tend to establish gradients away from financial and resource boundaries. Organisations will 'drift' towards the safety boundary as they seek efficiencies with finite resources or for other reasons pertaining to organisational culture.

This is not for dispute. For example, the investigation into the loss of the Royal Air Force Nimrod XV230 in 2006 resulting in the deaths of 14 service personnel found 'the Nimrod IPT [Integrated Project Team] allowed operational pressures and workloads ... to detract or distract from safety tasks'.¹⁴

In a well designed and managed safety system organisations will employ numerous measures to prevent drifting towards the safety boundary. But rather than rely on those measures alone, aviation authorities prevent breaches of the safety boundary by placing obligations on those responsible. They do this by regulating organisations and their personnel.

The independence of the regulatory decision making process distinguishes regulation from other forms of influence. Independence of safety regulators ensures a primacy on safety at all times and confers permanence of decisions.¹⁵ Whereas the regulated community achieves its objectives through managing resources, remaining financially viable and doing it safely, the sole objective of the regulator is safety.

The existence of a safety regulator does not mean those regulated view safety with any less importance than the regulator. But when subjected to competing priorities organisations can and sometimes do behave in a manner that is prejudicial to safety in ways that individuals within the organisation would not condone. But the very existence of an objective by definition cannot allow a single and permanent primacy on safety at all times. An independent regulator is not bound by this restriction. They have no other reason for being.

¹³ Haddon-Cave, C. (2009) *The Nimrod Review*, 'an independent review into the broader issues surrounding the loss of the RAF Nimrod aircraft MR2 XV230 in Afghanistan in 2006', The Stationary Office Limited, London, para 20.18.

¹⁴ Ibid, para 11.257 (square brackets added).

¹⁵ Rasmussen, J (1997) 'Risk Management in a Dynamic Society: A Modelling Problem', *Safety Science* vol 27 no 2/3.



Independence of a safety authority is a defining characteristic which distinguishes regulation from governance or day-to-day line management. Notwithstanding the definition of regulation at the start of this chapter, regulation cannot exist where independence from organisational influence cannot be established. Only when sufficient independence is established can the authority be considered a regulator.

Independence is not a binary characteristic, rather a scale that varies from no independence to full independence. Figure 2 is an example five-level scale, but it could consist of any number of levels.

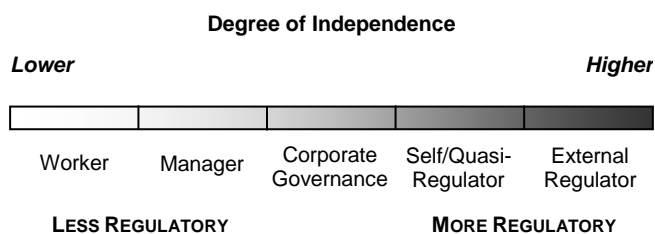


Figure 2. An example of the variation in regulatory independence.

A **worker** within an organisation has very little independence from organisational influence. This is expected as workers should be under the direction of management to align with organisational goals. **Manager** and **corporate governance** roles have increasing independence and authority as their ability to resist organisational influences driving them towards the safety boundary increases. But they are still part of the organisation meaning the level of independence required to focus solely on safety at all times remains limited. None of these positions hold a level of independence necessary to be a safety regulator.

Depending on the specific circumstances a **self-** or **quasi-regulator** role may achieve a level of independence adequate to be a safety regulator. An **external regulator** is further independent from organisational influence.

Independence of the regulator alone is not everything and does not necessarily equate to improved safety. Rather a regulator with more independence is more likely to avoid organisational influence by those it seeks to regulate. Strong independence but insufficient interaction with those it regulates results in an uninformed and increasingly irrelevant regulator. This was surmised by Sir Charles Haddon-Cave following Nimrod, in regards to the independence of a military aviation authority:

...the military element adds an entirely different dimension to the picture. The MOD [UK Ministry of Defence] has the responsibility for delivering a certain military capability and balancing risk with task. A military organisation must be 'risk sensible' but not too 'risk averse'. The MAA [Military Aviation Authority] must understand and appreciate operational relevance and, importantly, be seen by military operators to understand and appreciate this, if it is to enjoy their



confidence. In my view, it would not be sensible or practicable to position the MAA legally and physically outside the MOD.¹⁶

The takeaway is that the degree of independence of the regulator is an important characteristic of a regulatory regime that should always be consciously understood and managed appropriately.

RECOGNITION OF OTHER REGULATORY AUTHORITIES

A good regulator will do its utmost to ensure the obligations it places on the regulated community are most likely to be followed. One of the best ways to achieve this is by harnessing existing resources which support the objectives of the regulatory regime. In other words reuse the work of other regulators as much as possible. Furthermore, it is not always practical or cost effective for a regulator to undertake direct oversight over its own regulation. In such cases it may rely on another body to undertake oversight on its behalf. In some cases it may not even be practicable to directly regulate products or services obtained from a foreign nation.

All of these scenarios give rise to the concept of regulatory recognition. Recognition means being aware of the existing regulatory space and relying on existing arrangements as much as possible. The regulator should aim to steer, rather than row.

Recognition may be utilised to regulate for a particular set of hazards such as work, health and safety (the safety regulator may choose not to regulate as it is already regulated by legislation); for a particular activity such as oversight of quality management which relies on third party certification; or recognising the authority of an entire regulatory system such as a certification of an aircraft by the United States Federal Aviation Administration.

Recognition of other safety authorities can be achieved in three types of ways. **Unilateral recognition** is where an authority uses services of another regulatory authority, either with or without their knowledge, and without any specific tailoring. An example would be where an aviation safety regulator availed themselves of aviation standards and information made publicly available by another safety authority.

Bilateral recognition is where specific agreements are put into place between two authorities covering services provided to, or between, authorities and the conditions under which those services can be used. An example of a bilateral agreement would be where two authorities agreed to share specific design and support data for a common aircraft type.

Multilateral recognition is where specific agreements are put into place between three or more authorities covering services provided to, or between them, and the conditions under which that service can be used. Most of the Air and Space Interoperability Council (ASIC) and North Atlantic Treaty Organization (NATO) interoperability agreements are multilateral agreements.

¹⁶ Haddon-Cave, C. (2009) *The Nimrod Review*, 'an independent review into the broader issues surrounding the loss of the RAF Nimrod aircraft MR2 XV230 in Afghanistan in 2006', The Stationary Office Limited, London, para 21.16 (square brackets added).



Box 3: In-practice – TAREG 3.2.6.a.1 ‘Quality Management Systems’

An organisation-wide quality management system is fundamental to any assignment of engineering authority in Defence as it establishes a level of control and consistency over an organisation’s activities. Rather than re-regulate for the specifics of a quality system, Defence technical airworthiness regulation 3.2.6.a.1 requires engineering organisations to reuse an independent certification such as AS/NZS ISO 9001 or equivalent. This is a form of recognition. Defence recognises the existence of ISO9001 rather than regulating directly. Oversight and enforcement is provided by a third party auditor.

Since ISO 9001 does not meet all of the technical airworthiness requirements itself Defence specifically regulates for additional requirements and refers to it as an engineering management system (EMS).

INDEPENDENCE AND RECOGNITION

The 3 broad functions to regulate, to oversight and to enforce are depicted in Figure 3.¹⁷ It is important to realise each function need not be undertaken by the same organisation or personnel. For example, in one case the regulator may regulate, conduct oversight and carry out enforcement. In another circumstance the regulator may have limited resources and instead rely on another organisation to conduct oversight and enforcement on their behalf. Each function therefore may have a different level of independence in decision-making depending on the organisation responsible and their circumstances.

While there may only be one overall regulatory authority, by combining the characteristic of recognition it is quickly understood that regulation, oversight and enforcement of any safety domain including aviation, whether military or civil, is a patchwork of multiple organisations performing regulatory functions, each with a degree of independence as depicted in Figure 4. Recall that independence allows a primacy on safety. The regulatory regime therefore is only as independent as the least independent of the organisations involved in the regulatory functions.

¹⁷ In common language *Oversight* is not often used as a verb however its use here originates from *safety oversight*, an aviation term meaning to ensure effective implementation of safety-related standards and regulations.

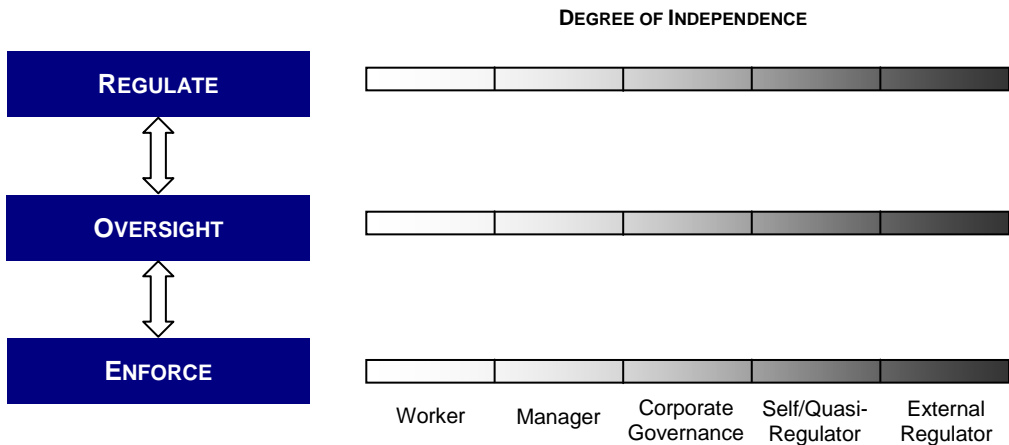


Figure 3. Each of the regulatory functions may have differing levels of decision-making independence.

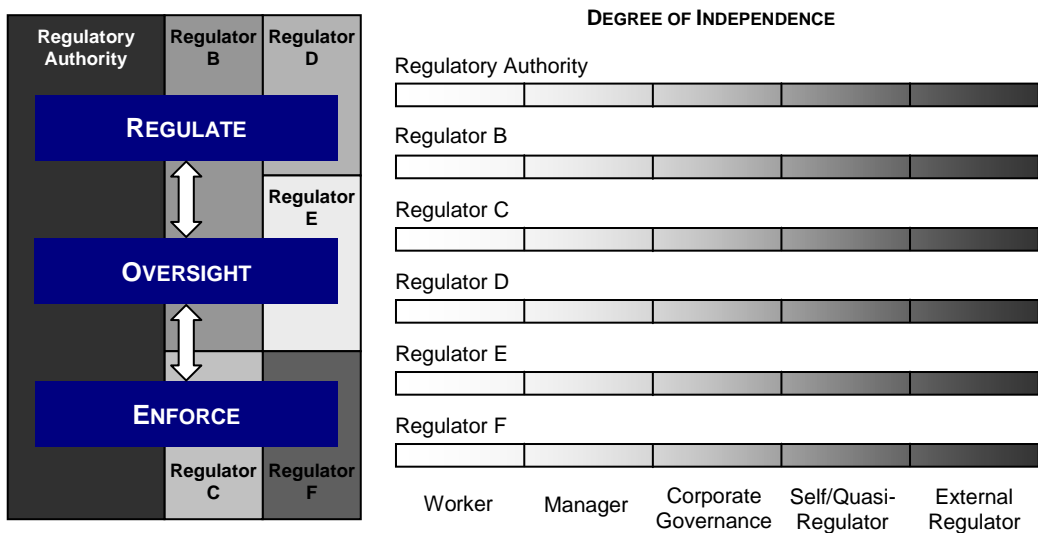


Figure 4. Each organisation responsible for a regulatory function may have a unique level of independence. In this example the regulatory authority relies on organisation B to prescribe a particular area of regulation and conduct oversight of that regulation (hence they are referred to as 'regulator B'). The regulatory authority must be comfortable the level of independence of regulator B is satisfactory to ensure a primacy on safety.



A MODEL OF REGULATION

PURPOSE

Models help to understand complicated structures of activities and stakeholders. The regulatory model explained here expands the three regulatory functions introduced at the start of this chapter. The model is referred to at the start of each subsequent chapter of this publication.

The characteristics of independence and recognition, whilst critical to understanding the role of a regulator are not included in the model as they provide no further help in explaining any of the subsequent chapters.

DESCRIPTION

It should already be clear that the regulatory process includes two groups of actors. The regulators and the regulated community (individually referred to as a 'regulated entity').

A safety regulator is responsible for the following elements in the regulatory process:

- (i) **Regulate.** Prescribing and amending regulation to place obligations on the appropriate recipients to achieve the regulatory objective.
- (ii) **Educate.** Providing explanatory material to support correct interpretation and effective implementation to satisfy the regulation.
- (iii) **Oversight.** Undertaking various activities to ensure that each regulated entity, and the products or services they produce, is compliant with the regulation. Oversight encompasses both the review that is done when issuing an approval for the first time and the surveillance thereafter.
- (iv) **Enforce.** Activities undertaken to ensure compliance when noncompliance is observed.
- (v) **Manage Relationship.** The various activities involved in interacting with each member of the regulated community. The manner in which a regulator conducts itself can be as important to the outcome as the content of the regulation itself. This is why all of the other elements should be thought of as flowing through the manage relationship element.

Each regulated entity is responsible for the following elements in the regulatory process:

- (i) **Interpret.** Understanding the intent of the regulation within their business context.
- (ii) **Implement.** The business activities undertaken to satisfy the regulation.
- (iii) **Adhere and Monitor.** Continuing to adhere with the regulation and undertaking various activities to remain regulatory compliant.
- (iv) **Manage Relationship.** The regulated entity manages their relationship with the regulator as they see fit, based on their level of trust, experience and other factors.



Other than when establishing a new regulatory system, these elements and the activities they comprise are undertaken concurrently and need not be sequential. Furthermore, the regulator would implement feedback mechanisms to improve each element.

The regulatory model is not intended to be a work flow diagram. Rather, the aim of this model is to assist in explaining the content of this publication, and will be referred to from time to time. Regulatory staff need not understand which element they are working on at any particular time. The model is merely a way of describing what the two key stakeholders in a regulatory process do and how they interact.

Furthermore it is not the intention of this publication to explain all the activities within each element. Rather this publication looks at some key areas of focus to achieve better regulation, commencing with the next chapter on hazard-based regulation.

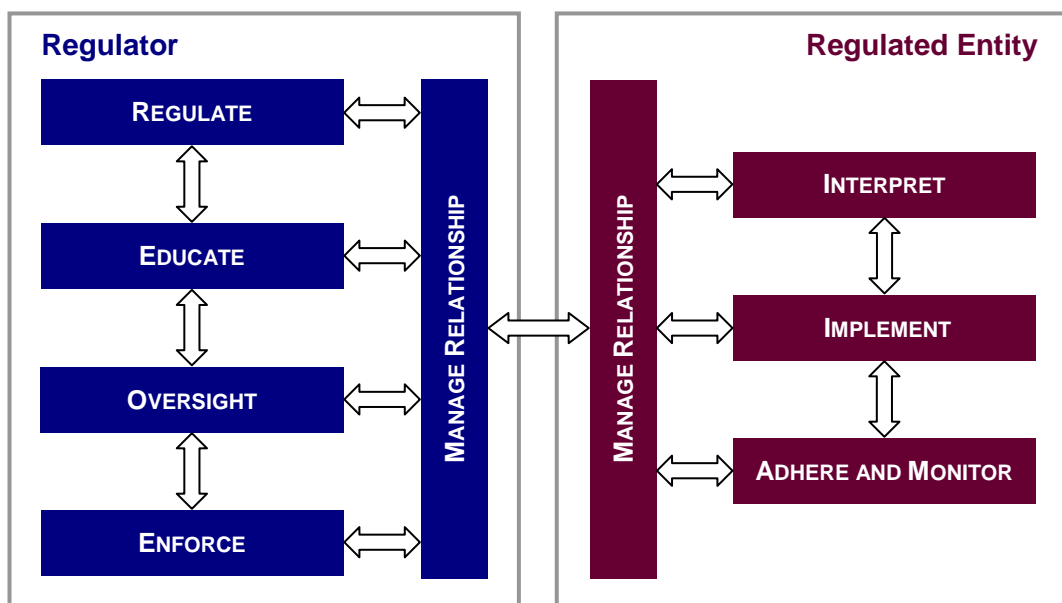


Figure 5. The regulatory model.







1. EMPLOY HAZARD-BASED REGULATION

SUMMARY

WHAT

Ensure regulatory obligations are only imposed to treat threats to aviation safety.

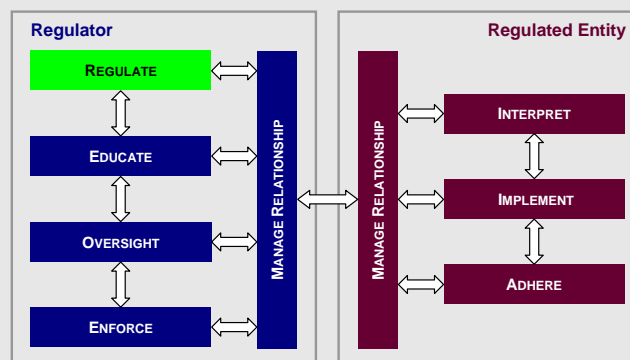
WHY

Without a proactive approach the regulator is responding to safety incidents in a reactive manner. A better way is to combine past learning with a proactive stance. The effect is increased focus on safety and reduction in cost of compliance by avoiding non-safety-related regulation.

How

1. Use a safety risk model to identify hazards which may eventuate into unsafe conditions.
2. Impose obligations through regulation and standard setting to enact defences to prevent the realisation of those hazards or their escalation into unsafe conditions.

Hazard-based regulation is a characteristic of the REGULATE function in the regulatory model.





EMPLOY HAZARD-BASED REGULATION – IN THEORY

INTRODUCTION

Knowing the scope and manner of what to regulate must be at the heart of being a good regulator. So how does a regulator ensure their regulations remain focussed on the objective?

Many factors will influence the regulator in its undertaking. First is a regulator's core idea about the nature of the world. If the regulator thinks the regulated community is immature or untrustworthy then it will administer prescriptive and punitive regulation. Conversely belief that the community is mature, competent and has the right attitude is likely to yield less prescriptive or punitive regulation.

Second is the ability to make decisions under conditions of uncertainty. When faced with an uncertain level of risk of a particular hazard or hazards, should the regulator adopt a 'worse case' presumption regarding the harms of activities? Or adopt a more positive stance to avoid potentially burdensome 'catchall' regulation, leaving the decisions about levels of risk retainment to others.

Third is whether the regulator is confident enough to be proactive rather than reactive. Without a proactive strategy to manage the stock of regulation over time the result is an ever increasing and potentially burdensome regulatory stance.

Finally, what are other similar regulators doing?

Unfortunately neither regulatory theorists nor practitioners have categorised the different approaches neatly. A review of approaches to safety regulation yields a bewildering array of language and terminology like those below. Such is the field of safety regulation. This chapter explores some of the above concepts and aims to explain a preferred, broad approach to aviation safety regulation known as hazard-based regulation. The terminology shaded in grey is discussed in later chapters.



KEY TERMINOLOGY

This publication intentionally avoids defining new terminology. However it is important to have a consistent understanding of language particularly in safety and risk communication. For this reason the following definitions are provided, according to ICAO.¹⁸

¹⁸ ICAO (2013) *Safety Management Manual* Doc 9859 3rd edn, s 2.13 and 'Definitions'.



A hazard is a source of potential harm. An aviation **hazard** is a condition with the potential to cause or contribute to unsafe operation of aircraft or aviation-safety-related equipment, products or services. A hazard should not be confused with a consequence. A **consequence** is an outcome of an event triggered by a hazard, and may be multilayered, including such things as an intermediate unsafe outcome before an ultimate consequence (accident). By first defining the hazard one can then project the consequence. Safety **risk** is a different concept altogether, being the likelihood and severity of the consequence of a hazard.

A safety **threat** represents a specific failure or loss of control mode through which a hazard can materialise. Threats may be thought of as system or equipment failure modes identified through a structured review process which act to defeat the protection of a hazard.

Hazards are an inevitable part of aviation. However their manifestation and possible consequences can be addressed through various mitigating actions. A **defence** is a broad term meaning any specific mitigating action, barrier, control or recovery measure put in place to prevent the realisation of a hazard or its escalation into an undesirable consequence.

As an example, a strong wind blowing parallel to the runway is not necessarily a hazardous condition and will improve take-off and landing performance. However the same wind blowing in a direction perpendicular to the runway creates a crosswind condition that may be hazardous. Multiple threats could be identified in the crosswind landing example. One example is the loss of control on landing with a consequence of wing strike with the ground. The ultimate consequence could be a catastrophic accident. A limitation on the maximum allowable crosswind landing is an example of a defence to prevent loss of lateral control (the threat) in a strong crosswind (the hazard).

REGULATORY STANCE

Accidents or incidents are typically the malevolent coming together of a set of events and circumstances. It is this coming together of all the elements that in itself, creates the critical unsafe state of the system. For almost every aviation accident or incident the subsequent systemic investigation has shown that:¹⁹

- (i) The main contributing systemic factors were present before it happened.
- (ii) In most cases they were relatively common knowledge, and had often been formally documented.
- (iii) In all cases, they could have, and should have, been identified and rectified before the accident or incident.

¹⁹ Lee, R (2009) 'Maintaining and Enhancing Operational Safety in a Turbulent Aviation Environment: the Critical Role of Integrated Safety Management Systems', in *Proceedings of the Safeskies Conference*, Canberra.



An accident therefore can be viewed as a sequence of events that unfold over time. Contributing factors can be traced back by unfolding the chronology of events as depicted in Figure 6.²⁰ Each stage in the chronology of an event is a potential intervention point. The stance of a regulator is either reactive or proactive depending on when it intervenes.

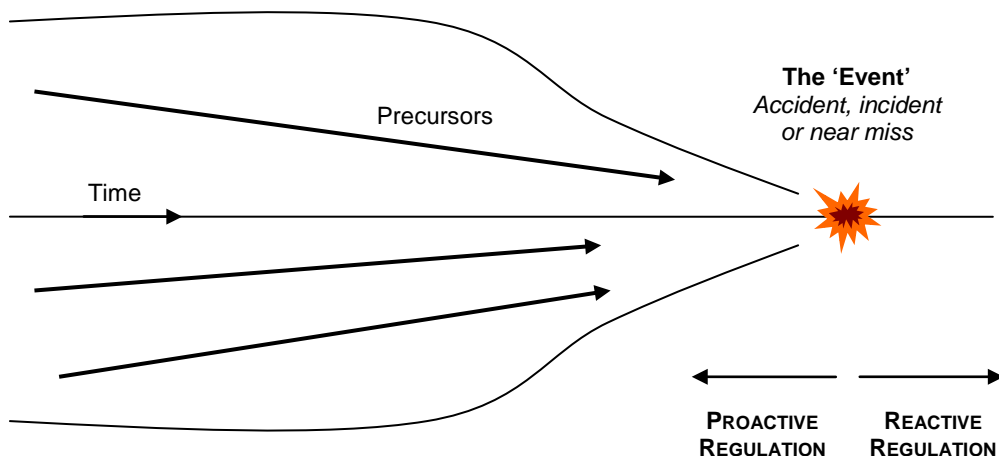


Figure 6. A regulators stance is either reactive or proactive depending on when it intervenes.

REACTIVE REGULATION

The reactive approach to regulation is built on historical events. Each accident or incident is reviewed and additional regulatory controls are put in place to prevent the same or similar hazards from manifesting again, only limited by cost. One of the appeals of reactive regulation is the ease of measuring regulatory success. Numbers of repeat incidents, accidents, or violations provide unambiguous and objective measures.²¹

Over time the stock of regulation grows and continues to grow as there is always a reluctance to remove existing regulatory interventions for fear of releasing a risk back into the regulated community. The result is a stock of regulation at any point in time which is the end result of a sequence of previous events. However, without a clear connection as to its purpose reactive regulation over time provides little or no awareness of the hazards which it was designed to control. The existence of reactive regulation can deaden the awareness of the hazards which the rules intended to control.

²⁰ Sparrow, M (2008) *The Character of Harms: Operational Challenges in Control*, Cambridge University Press, pp 137.

²¹ Ibid, pp 136.



PROACTIVE REGULATION

The proactive approach involves sliding up the chronology of any potential event before it occurs, examining the full range of precursors, and the precursors to the precursors, searching for opportunities to remove, restrain, or divert some essential ingredient or ingredients and thus reducing the possibility of the hazard materialising. This systematic approach to regulation has driven the need for safety management systems – an example of proactive regulation.

Proactive regulation means regulating uncertainty. How does the regulator know what is going to happen in the future? Conceptually this may be classified into three ideal type categories:²²

1. The harm the activity will cause is known and determinate. For example intentional incorrect fitment of an aircraft wheel will certainly result in an unsafe condition.
2. The harm is probabilistic in character. In other words certainty is impossible to know but it can be estimated based on probability theory. For example the safe life approach to design of structurally critical aircraft components is probabilistic. Safe life components are designed with an accepted, albeit extremely low, probability of failure through thorough testing and analysis.
3. The probability of harm occurring and/or its magnitude is indeterminate. For example maintenance performed by personnel with insufficient experience may contribute to harm at some time in the future. However the likelihood or consequence of this hazard manifesting is almost impossible to determine to any degree of accuracy.

Aviation lends itself mostly to type 3 cases due to the complex nature of technological, human and organisational factors many of which are difficult to model. Regulation to avoid harm due to type 3 cases may be referred to as **hazard-based** regulation. Type 2 cases in aviation are less common, usually in the design and certification domain where engineers are able to model failure modes to some degree. Type 2 regulation may be referred to as **risk-based** regulation. Type 1 cases are the realm of deliberate acts or gross omissions or neglect that are so obvious so as to cause harm they are typically not directly regulated by Defence aviation safety regulation. Such instances are the domain of broader legislation or the common law and therefore not discussed further.

Proactive regulation, whether risk or hazard based will have to rely on a constant flow of information and data, which, following analysis, should provide an indication of the actual safety performance including identification of emerging hazards before they cause harm. 'Safety indicators' are discussed in chapter 7.

What makes the discussion rather more complicated, however, is in regulatory theory the term risk-based regulation is overused to mean almost anything while hazard-based regulation is used rarely. A short description of each therefore follows.

²² Stewart, R (2002) 'Environmental Regulatory Decision Making Under Uncertainty', *Research in Law and Economics*, vol 20.



RISK-BASED REGULATION

Risk-based regulation is a term utilised widely but differs in meaning. In this publication we mean the application of a systematic framework that prioritises and prescribes regulation to manage hazards on an evidence-based assessment of safety risk.

The benefit of a risk-based approach is less burdensome regulation. However the ability to assess risk accurately requires statistical distributions. Risk-based regulation is therefore the preferred approach in fields where risk can be clearly understood such as in the use of chemical substances where it is possible to determine probabilistic estimates of the safety risks associated with their use.

An example is the Therapeutic Goods Administration (TGA). The TGA is the Australian Government entity responsible for regulation of medicines and medical devices. The use of any therapeutic good carries health risks. One of the roles of the TGA is to regulate therapeutic products based on scientific and clinical assessment of the evidence of those risks compared to their benefits. As an example some medications to control high blood pressure may include side effects such as a persistent cough. However, the risk of this irritation is balanced against the possibility of a life-threatening heart attack if the medication is not used.

The amount of regulatory control needed to manage risks depends on the product and determines how consumers gain access to the product. A low-risk product may be safely sold in a supermarket; higher risk products may only be supplied by prescription after consultation with a health professional. A medication with unacceptable risks will not gain approval to be sold at all.

Unfortunately risk-based regulation does not accommodate low occurrence, high consequence events particularly well, as is prevalent in aviation and nuclear power generation industry. In such scenarios the probabilities needed are often not available and cannot be estimated, resulting in a default to hazard assessment (type 3).

In this publication risk-based regulation is not taken to include *risk-based oversight*. Risk-based oversight, discussed in chapter 8, is an approach to the allocation of resources to the oversight role based on an assessment of risk. They are different regulatory approaches as explained in Figure 7.

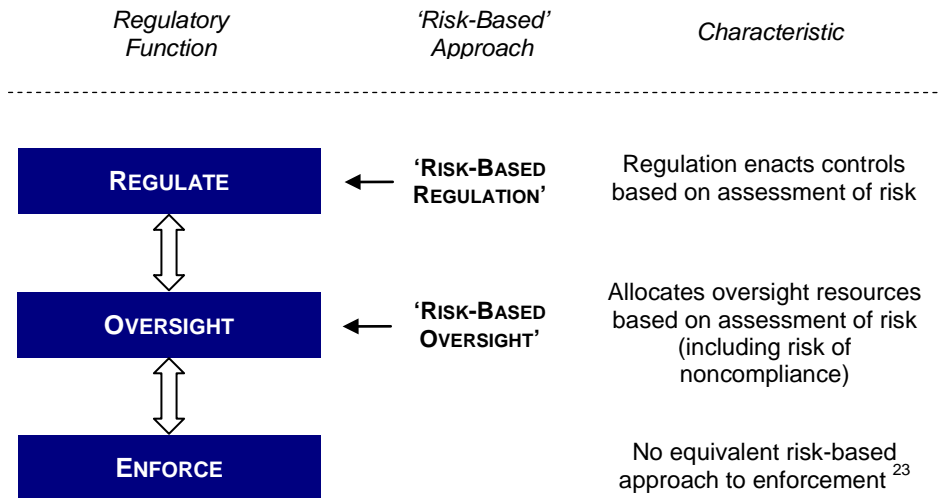


Figure 7. Risk-based regulation and risk-based oversight are not synonymous.

HAZARD-BASED REGULATION

Hazard-based regulation is the application of a systemic framework that prioritises regulation on an assessment of hazards. Hazard-based regulation ensures regulatory obligations are imposed to treat threats to safety where the safety risk of those threats cannot be estimated.

Hazard-based regulation starts with a risk model to analyse hazards which may materialise. The regulations then place obligations on those regulated to create the necessary defences to prevent the hazard from materialising. The benefit of hazard-based regulation is that it is proactive and increases focus by avoiding non-safety related regulation that may creep into reactive regulatory approaches.

Whilst the data needs of hazard-based regulation are less than risk based the major problem is the recognition that the most serious scenarios cannot be identified from a general rule even where data on past events exists. So the approach to regulating hazards can be either weak or strong form. The weak form holds that the lack of evidence of a risk should not automatically initiate regulation or measures to prohibit the activity ('hazardous optimism'). The strong form of the principle asserts that regulation is required whenever there is a possible adverse risk, even if the supporting evidence is speculative and even if the economic costs of regulation are high ('prudent pessimism').

²³ Nil enforcement action based on assessment of the risk of noncompliance is illogical and undermines the regulation. Graduated response to enforcement is a better way and is described in chapter 9.



Either way hazard-based regulation does not necessarily mean the hazard is removed entirely as it often cannot be (recall the crosswind example). Hazard-based regulation mandates defences to reduce the risk of the hazard materialising. A responsible person at some point will need to decide whether the level of defence is adequate. This may be the regulator or the regulated entity depending on whether the regulation is drafted prescriptively or in an outcome-based style (discussed in chapter 2).

For example, a regulation requiring authorisation of design engineers every 12 months is the regulator explicitly setting a standard. But how can the regulator know that 12 months is satisfactory? An alternative is an outcome-based style which may require the regulated entity to determine the minimum authorisation period themselves according to their own assessment of their circumstances.

RISK TOLERABILITY

The fundamental question in any regulatory regime is how much risk is the regulator prepared to tolerate. Regulators do not often articulate what their risk appetite is in public, or even private. But who should apply the tests and make tolerability decisions? The answer is probably all stakeholders (the risk creator, those at risk, and the regulator). As acceptance of risk depends on the potential benefits, there are likely to be differences between stakeholders in perception and opinion.

In risk-based regulation the regulator is explicitly stating the level of risk tolerance. For example stipulating a design standard for an aircraft system is a risk-based approach because inherent in that decision is a level of risk. A move towards outcome-based regulation obligates the regulator to consider who is assessing the risk. Hazard-based regulation does not necessarily require the regulator to assess risk. It may place the risk assessment on the regulated communities. The regulator, if involved, assesses the discharge of both the risk-creator's and the risk assessor's responsibilities.

SIZE AND SHAPE OF HAZARDS

The size of a hazard drives the granularity of regulation. At the lowest level, attention might be focussed on a problem so small and so particular that it really represents one incident or violation and is really not a pattern at all. An incident may be part of a pattern, but is not a pattern by itself. Focussing attention at the finest level of granularity moves practitioners below the level for effective problem solving and back into a reactive case-by case processing mode.

The opposite extreme is where problems being addressed are not specific at all, but are bundles of disparate objects, all lumped together. At this level one considers generalised classes of problems and weighs the merits of generalised classes of response. At this macro level of regulatory attention insufficient granularity means patterns of incidents or violations are missed entirely.



In between the two extremes is where the most fruitful regulatory work lies.²⁴ Whilst difficult to define, the best advice is to think about individual incidents from the point of view of incident response. If the organisation responsible already has processes and procedures established to handle such an event (but they failed) then focus on enforcement of those processes and procedures. Avoid regulating for more granularity when sufficient granularity already exists.

BOW-TIE ANALYSIS

This chapter has explained the difference between hazard and risk-based regulation and considered the size of hazards to be controlled. One way of visualising this is using an adapted bow tie model. The model provides a way of understanding how hazard-based regulation enacts defences against safety hazards. But first is an explanation of the bow tie risk model.

INTRODUCTION TO BOW TIE

Bow tie (or cause and consequence) risk models are a diagrammatic representation of the relationship between the management system and the hazards being managed, by linking hazards and their consequences through event lines illustrating the routes to undesired events. The bow-tie tool therefore facilitates an in-depth proactive assessment of hazard defences.

Bow-ties are most commonly used where there is a requirement to demonstrate that hazards are being controlled, and particularly where there is a need to illustrate the direct link between the controls and elements of the management system.

A generic bow tie risk model is depicted in Figure 8. Bow tie risk models are based on:

- (i) Identifying a loss of control event;
- (ii) Identifying possible causes for a loss of control event;
- (iii) Identifying possible consequences following a loss of control event;
- (iv) Identifying defences to prevent possible causes of a loss of control event; and
- (v) Identifying defences to reduce or eliminate the consequence resulting from a loss of control event.

BOW-TIE TERMINOLOGY

In addition to the earlier definitions, a further set of terminology is used in bow-tie methodology.²⁵

The **top event** is the point at which control of the hazard is lost resulting in a change of 'state'. Using the crosswind example, the top event would be loss of lateral control of the aircraft on landing.

²⁴ Sparrow, M (2008) *The Character of Harms: Operational Challenges in Control*, Cambridge University Press, pp 79.

²⁵ Department of Defence (2012) AAP6734.001 *Defence Aviation Safety Manual*, chap 7, annex E.



The **Consequences** are the final results that could occur in the event of the entire accident sequence mapped on the bow tie being realised. In other words, what will happen when a loss of preventive control releases a hazard (a 'top event') and the recovery controls fail? In the crosswind example a consequence could be a wing striking the ground.

Preventive controls are the mechanisms put in place to prevent the release of a hazard resulting in the top event. A maximum crosswind limitation is an example to prevent against loss of lateral control on landing.

Recovery controls are the mechanisms put in place to recover control following occurrence of the top event. In the crosswind example a recovery control could be an established go-around procedure.

Escalation factors are latent conditions/factors which act to weaken the effectiveness of controls. An example applicable to the preventive control crosswind limitation would be an ambiguous description of the maximum crosswind in the operating procedures resulting in misunderstanding amongst flight crew as to its purpose (e.g. mandatory or recommended?).

Escalation controls are mechanisms put in place to prevent escalation factors from affecting the performance of controls. An example is flight crew training with the go-around procedure in a simulator prior to initiating it for real.

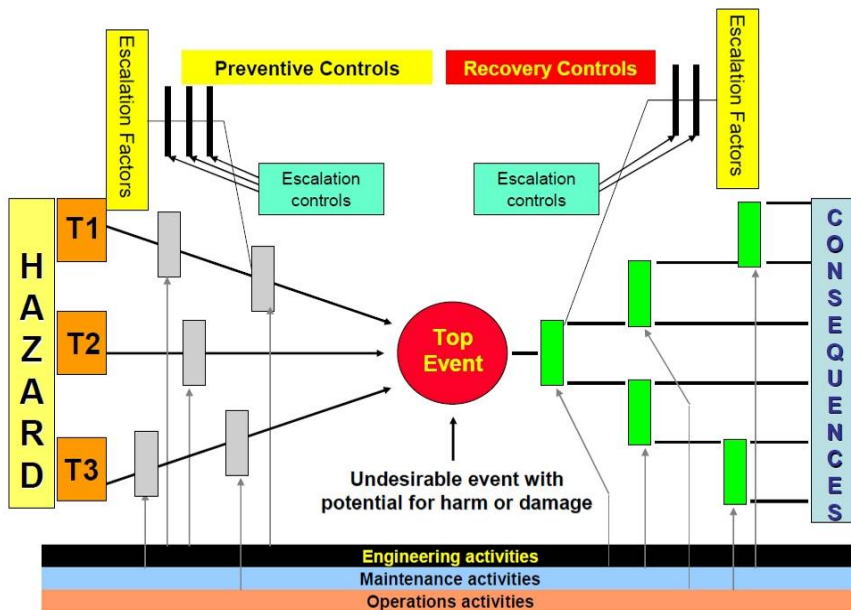


Figure 8. A generic example of a bow tie risk model.



EMPLOY HAZARD-BASED REGULATION – IN CONTEXT

There is no such thing as an accident.

*What we call by that name is the effect of some cause which we do not see.*²⁶

A BETTER WAY TO REGULATION

Traditional Defence aviation safety regulation adopted a reactive approach, prescribing precise measures based on previous experience. But in the past two decades we have seen a marked change in the way safety regulation is framed by professional regulators across the world. Due to the complex systemic organisational factors involved, aviation professionals realise the regulator cannot always be in a position to assess every risk and mandate every defence. Furthermore, regulation which is silent on the actual hazard it intends to protect against can become unwieldy as the hazard is slowly lost in regulatory minutiae, which is itself a potential threat to safety in the longer term.

The management of safety is, and has always remained, in the hands of operators, their equipment maintainers and engineers. Acknowledging this, and to re-establish the awareness of the hazards which the regulations intend to control, **Defence aviation safety regulators should employ hazard-based regulation.**

APPROACH TO HAZARD-BASED REGULATION

The benefits of hazard-based regulation are to:

- (i) Return the focus of regulation on safety hazards;
- (ii) Remove regulation not related to defences against those hazards ('cut red tape'); and
- (iii) Clearly place the management of risks associated with hazards on those in the correct position to control them.

The three broad steps to hazard-based regulation are:

1. Identification of aviation safety hazards;
2. Identification of the characteristics of defences to protect against those hazards; and
3. Drafting of regulation to obligate the correct people to enact those defences.

²⁶ Voltaire (1694-1778).



Box 4: In-practice – technical airworthiness regulations are not hazard based

Figure 9 is the proportion of regulatory clauses in the technical airworthiness regulations (TAREGs) that are not regulation. Almost 40% of the 2013 suite of TAREGs are not regulation of any kind (let alone hazard-based). Many are administrative in nature ('red tape' not contributing to safety) or good process guidance which need not be regulation. The concern for the long term is that the focus on the hazards and their safety risks will be lost.

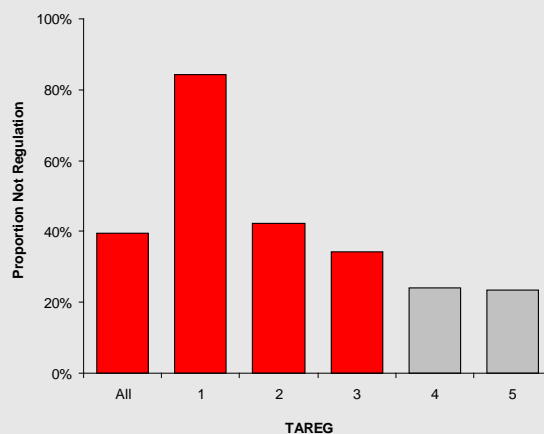


Figure 9. The proportion of TAREGs that are not regulation (red indicates highest proportions).

PBP BOW TIE FOR REGULATION

Hazard identification for a specific task or activity is often challenging enough. It is not practical for an aviation safety regulator to attempt this for every aircraft and support system. Hazard mapping using an adaptation of the bow-tie model is a more practicable way of identifying and justifying safety regulation and identifying ineffective and unnecessary regulation. The resulting bow-tie not only describes what regulations are in place today, but why they will still be there tomorrow.

The Process Behaviour Product (PBP) bow tie model for regulation is based on a generalised bow-tie model and modified by considering causes and consequences in generic threat groups across life cycle categories.²⁷ The PBP bow tie model provides a structure for the systematic representation and analysis of safety regulation regimes. The features and concepts of the model are:

²⁷ Purton, L; Kourousis, K; Clothier R; Massey, K (2014) 'Mutual Recognition of National Military Airworthiness Authorities: A Streamlined Assessment Process', International Journal of Aeronautical and Space Sciences, vol 15 no 1, pp 54-62



Top Event. For aviation and aviation support systems the top level event could be an 'undesirable operational state' or similar.

Loss of Control. The loss of control of the top event is dependent on the responsibilities of the regulator. Where separate technical, operational and aviation support regulatory regimes are in place then the loss of control states would be:

- (i) Loss of technical integrity;
- (ii) Loss of operational integrity; or
- (iii) Loss of aviation support integrity.

Loss of Control Considerations. Although a little difficult to conceptualise, a technique that has shown some promise in helping to maintain a generic and complete outlook when trying to identify generic causes, consequences and controls has been to consider the loss of integrity in terms of pluses and minuses. It may be possible to use this method to capture and consider failure or loss of control modes. The technique considers:

- (i) A physical (P) attribute or presence that we have but do not want (+P), e.g. foreign object.
- (ii) A physical attribute that we want but do not have (-P), e.g. missing or unserviceable item or service.
- (iii) A physical attribute or component that interferes with another physical attribute or component (P/P), e.g. oversize cargo load.
- (iv) A functional (F) attribute that we have but do not want (+F), e.g. excessive power, a product that hardens before it can be applied properly.
- (v) A functional attribute that we want but do not have or is missing (-F), e.g. insufficient power, absence of electronic counter measures.
- (vi) A functional attribute that interferes with another Functional attribute or operation (F/F), e.g. electromagnetic interference.
- (vii) An operator (O) exceeds operational parameters (+O), e.g. excessive G forces, or over torque/tightening a fitting/cable.
- (viii) An operator fails to understand or operates incorrectly through ignorance or denial (-O), e.g. fails to follow operating instructions.
- (ix) An operator interferes with or impedes another operator (O/O), e.g. collision, or distraction during a vital operation.

Service Events. Each type of service (or information) needs to be considered separately to determine what could go wrong to cause a loss of control. To help do this in a generic and independent way, each of these events are considered along product, process and behaviour threat lines, and subcategory activities are used to denote significant activities in the life cycle and use of



technical equipment. Product, process and behaviour threat lines are proposed because throughout the world regulations are generally applied to products, processes and behaviour, regardless of what is actually being regulated. For technical integrity the subcategory activities could be design, production, maintenance and distribution. Similar subcategories exist for operational integrity.

Consequences. For each type of service and loss of control, we determine what could be the likely consequences of a loss of control.

Preventive Controls. To reduce the likelihood of a loss of control occurring, practicable and appropriate controls are proposed (where possible) for each threat line and activity.

Recovery Controls. To reduce the consequences resulting from a loss of control, practicable and appropriate controls are proposed (where possible).

The basic layout of the PBP bow tie model structure is illustrated in Figure 10. Conventional bow tie models in aviation safety are utilised to assess the controls in place, to reduce the likelihood, or reduce the consequence of a potential hazard, triggered by a specific event. In the PBP bow tie model in this example the top event is the loss of technical integrity. Technical integrity can be maintained by assuring product, behaviour and process (PBP) integrity. The three elements establish a set of threat lines potentially leading to a loss of technical integrity, and in turn, ultimate consequences.

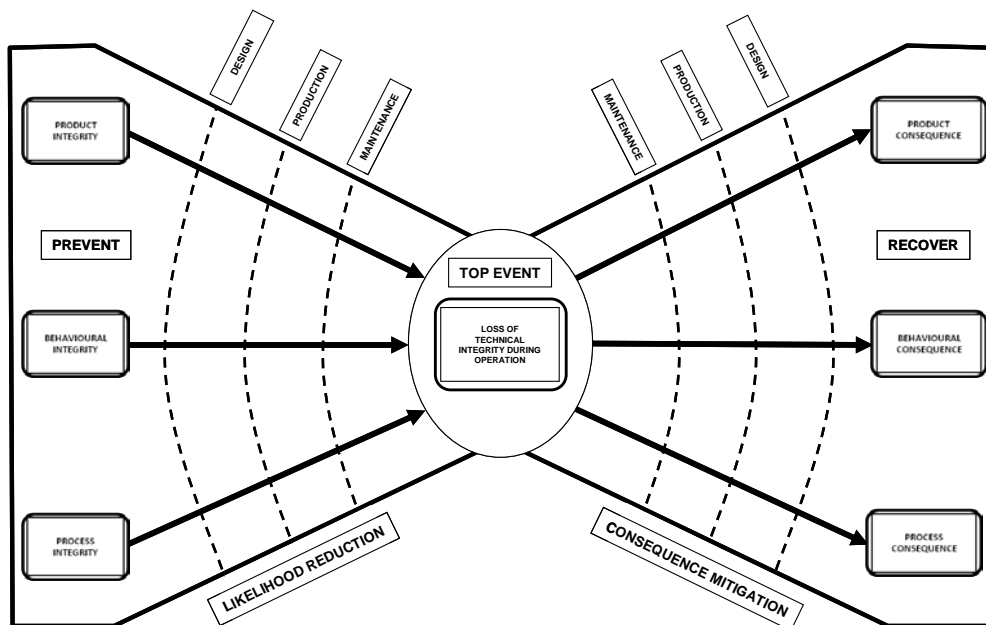


Figure 10. Composition of the PBP bow tie model for loss of technical integrity.



Controls can be put in place to reduce the likelihood of any threat line eventuating. Within the technical item lifecycle, there are three distinct activities: design, production and maintenance. Controls are grouped in relation to these three activities. Controls are also grouped as preventative (grouped on the left-hand side of Figure 10) or recovery (grouped on the right-hand side).

Each control represents one or more specific regulatory obligation.

While this bow tie example focuses on the top event of loss of technical integrity during operation, operational controls could also be introduced into the same bow tie on the recovery (right-hand) side to recover from a loss of technical integrity.

HAZARD-BASED REGULATION AND THE PBP BOW-TIE

The purpose of describing the PBP bow tie model here is to show how it can be used to identify and justify safety regulation and identify ineffective and unnecessary regulation. Firstly, a hazard-based regulation enacts a control or escalation control on the PBP Bow-Tie. If a regulation cannot be visualised on the model it is most likely not addressing a hazard and its utility to safety assurance should be questioned. Secondly, the bow tie not only describes what regulation is in place today, but can be used to explain why it should still be there tomorrow.²⁸

It is important to note that risk-based regulation does not lend itself to visualisation on the PBP bow tie model. While the model would look the same, bow tie does not consider likelihood because it was never designed for the detailed quantitative assessment of risk. Therefore plotting risk-based regulation on a PBP bow tie model is potentially misleading.

²⁸ Readers should be aware the PBP bow tie model was developed for the purposes of comparing different aviation safety regulatory regimes by identifying 'test-points' within each regulatory framework. The use of the model here to identify and justify controls to be enacted through regulation is therefore a more simple use of a tool that is of further utility but beyond the scope of this publication.



Box 5: In-practice – comparison of ‘process regulation’ and ‘product standards’

Most product-based standards are inherently risk based regulation because product standards set risks levels (during certification). For example the certification of a gas turbine engine is based on a possible (albeit very small) chance of catastrophic structural failure. The design of gas turbine engines is regulated through the certification process to prevent catastrophic failure resulting in the loss of the aircraft based on an assessment of risk. Such failure modes could occur due to the failure of critical high speed rotating components whose failure will likely result in the release of high-energy debris that cannot be contained within the engine such as disks and shafts.

One failure mode of such parts is through fatigue. Fatigue is not managed by hazard-based regulation. Instead regulation (certification) requires that the likelihood of an engine critical part failure is so remote as to be considered airworthy (FAR 33 requires hazardous engine effects are predicted to occur at a rate not in excess of one in 10 million events per flight hour).²⁹

The Defence publication AAP7001.054—*Airworthiness Design Requirements Manual* sets Defence’s preferred design standards. Design standards are mostly risk-based regulation because they incorporate some level of inherent risk of failure (which may be impossible to quantify but nevertheless considered small enough based on past experience). With its focus on product standards risk-based regulation is similar to quality control.

The Technical Airworthiness Regulations (TAREG) in AAP7001.053—*Technical Airworthiness Management Manual* is mostly process type regulation. These regulations tend not to incorporate risk levels because they are less scientific. Instead they should remain hazard-based where the level to which a hazard is managed on a case by case basis and in many cases left up to the regulated entity. With its focus on process, hazard-based regulation is similar to quality assurance.

²⁹ United States Code of Federal Regulations, 14CFR33.75 (2007).



Box 6: In-practice – example of a hazard-based aviation software regulation

Hazard	Preventive Control	Example Regulation
Unspecified anomalies within aviation software could result in hazardous behaviour of aircraft software (control or aircraft, system performance or misleading displays)	Apply software assurance to ensure that appropriate rigour has been applied during design commensurate with the worst-case failure condition associated with aviation software. Software assurance provides confidence that software will provide appropriate behaviour where needed to provide that behaviour.	<i>The applicant must ensure that:</i> Aviation software must be assured to perform its intended specified functions, to provide confidence that performance will be appropriate and safe.
Improper assessment of software assurance could result in unintended or unsafe behaviour of aircraft software.	Provide oversight to assure that the evidence, methodology and compliance finding agencies that will be used establish compliance with design benchmarks are reasonable.	The means of establishing assurance for aviation software providing or controlling functions that could cause a fatality or serious injuries must be submitted to the TAR prior to the conduct of compliance finding.
Incorrect software configuration could result in hazardous behaviour of aircraft software.	Integrity - Load Control / CM	Controls that assure only the intended approved aviation software configuration is installed in aircraft equipment shall be established.
Known anomalies could result in hazardous behaviour of aircraft software.	Integrity - Problem Reporting	Unsafe anomalous behaviour of aviation software must be: - identified and tracked; and - unsafe behaviour that results in aircraft hazards should be subject to risk management
Unsafe behaviour specified in the design of aviation software, failure to provide protection from erroneous input, or failure to appropriately specify safe behaviour could result in hazardous behaviour of aircraft software.	Safety - System Safety, Software Safety	The safe appropriate behaviour of aviation software must be defined within software design, such that (i) requirements state expected safe behaviour, and (ii) software behaves in a safe manner when subjected to abnormal input.





2. MAXIMISE OUTCOME-BASED REGULATION

SUMMARY

WHAT

Where possible, focus regulation on the outcome needed to treat threats to safety and not the means to achieving that outcome.

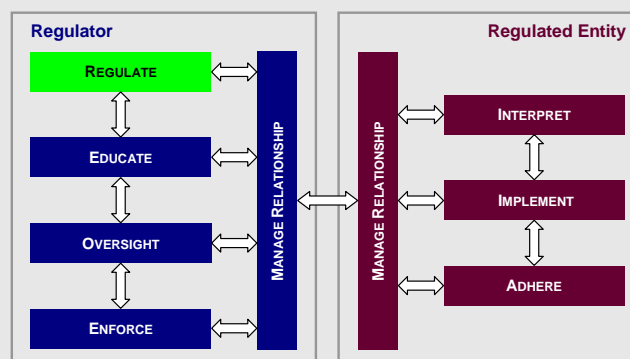
WHY

Affords more flexibility to regulated entities to develop and implement a range of lower cost management solutions while achieving the same level of safety assurance. Regulated entities are better placed than regulators to determine what processes and actions suit their business to satisfy a regulatory objective. So regulators, instead of focussing on prescribing actions that organisations must take, step back and define the outcome required.

How

Draft each hazard-based regulation to focus on what the control is intended to achieve, rather than the means by which it should be achieved.

Outcome-based regulation is a characteristic of the REGULATE function in the regulatory model.



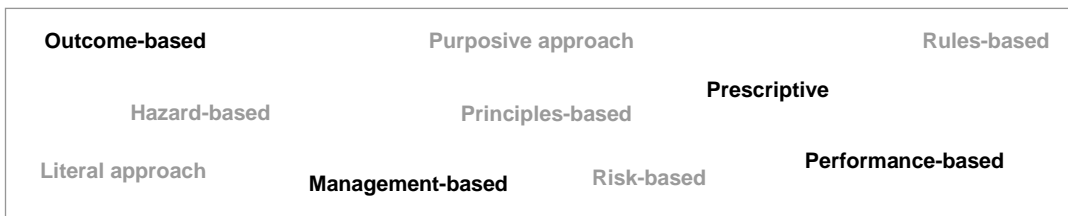


MAXIMISE OUTCOME-BASED REGULATION – IN THEORY

INTRODUCTION

The primary aim of regulation is to influence behaviour and affect a particular outcome. Conceptually this sounds simple. But it involves communicating requirements with written language. As with any written language, the style, tone and level of detail can significantly influence comprehension.

Regulation can prescribe required behaviour or it may set goals for the outcome of behaviour without detailing how it should be achieved. The level of specificity may also vary widely. The style of regulation therefore is an important characteristic that should be understood and considered. The following terminology is often used to describe regulation. Hazard-based was explained in chapter 1. Those in bold are regulatory styles and discussed in this chapter. The remaining terms are introduced in later chapters.



REGULATORY STYLE – DEFINITION

Consider the following examples, which all aim to achieve the same objective:

Example 1. *The applicant shall review for accuracy 10% of all flight manual pages every month.*

Example 2. *The applicant shall establish procedures to ensure that flight manuals are correct.*

Example 3. *The applicant shall establish a system to ensure all documentation and publications used to support safe operation of the aircraft are correct and authorised.*

Which of these examples will be most effective? Or efficient?

There is no simple answer. It depends on the circumstances, the extent and history of previous regulation, organisational cultures of members of the regulated community and the ability and capability of the regulator to conduct oversight and enforcement. This chapter provides some theory to understand *why* the above examples are different and *when* each of the styles would be best utilised.



STYLE OF INTERVENTION

Very simply, organisations exist to achieve something. They do this by:

1. Planning to do something;
2. Acting to output something; and
3. Achieving an outcome (and comparing against what was planned).³⁰

The introductory chapter explained that regulation exists to influence behaviour to affect a particular outcome or prevent an undesirable occurrence. Regulation targeted at any stage of production will potentially affect outputs. We can therefore distinguish between styles of intervention based on the location of the regulation in the stage of production, as explained in Figure 11.³¹

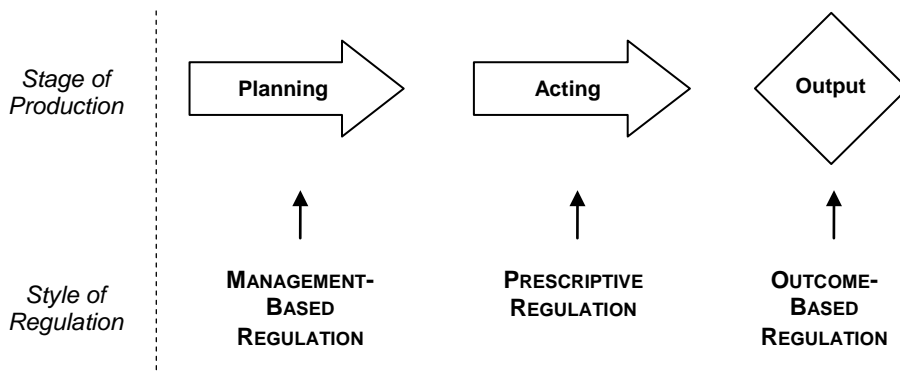


Figure 11. Regulation can be designed to influence organisations at different stages of production.

Working from the right, **outcome-based** regulation specifies the required output to be achieved. No reference is made as to the manner in which the outcome is to be achieved and therefore provides a degree of freedom to the regulated to determine compliance.

Regulation intervening in the acting stage is **prescriptive** regulation by specifying technologies to be used or processes to be followed.

Management-based regulation neither explicitly imposes the means nor the ends. It intervenes at the planning stages and directs those regulated to engage in a planning process that aims toward

³⁰ This aligns with the quality management principles of 'plan, do check'.

³¹ Adapted from Coglianese, C and Lazer, D (2003) 'Management-Based Regulation: Prescribing Private Management to Achieve Public Goals', RPP-2003-08, Center for Business and Government, John F. Kennedy School of Government.



the achievement of the regulatory goal, offering organisations flexibility in how they achieve those goals.

OUTCOME BASED

Also known as 'performance-based' regulation.

Outcome-based regulation is regulation that specifies the required outputs to be achieved. In other words it defines the required performance. It makes no reference to the manner in which the outcome is to be achieved and therefore provides a degree of freedom to the regulated community to achieve compliance.

Attractive for its flexibility, outcome-based is appropriate when the output can be measured and its impact evaluated against the desired objective of the particular regulatory defence it enacts. In addition to flexibility, benefits include ability to accommodate technological change in ways prescriptive regulations focusing on a specific technology cannot.

On the negative side, regulatory staff who are used to enforcing relatively straightforward prescriptive standards are more likely to be uncomfortable with the discretion inherent in assessing outcomes. Finally, outcome-based regulation makes it difficult to assess the potential resource impact of a regulatory change on the regulated community due to its focus on outcomes rather than the actual work undertaken.

PRESCRIPTIVE

Also known as technology-based regulation.³²

Traditionally regulators have relied primarily upon prescriptive regulation. In varying levels of detail, this type of regulation specifies how work is to be done with the expectation of strict compliance. The presumption is following the rules will bring about the desired regulatory outcome.

Prescriptive regulation is appropriate where there are single, commonly agreed means of controlling a hazard. Advantages include certainty and clarity. The most important use of prescription is to enable interoperability amongst the regulated community through standardisation. Examples in civil aviation include rules of the air, carriage of dangerous goods and aircraft marshalling.

Disadvantages include inflexibility, the liability of becoming outdated, stifling of innovative regulatory compliant solutions and high administrative and compliance costs. Prescriptive rules can also contribute to their own defeat through creating a culture of regulatory decision making according to

³² Design standards are included within the definition of regulation if there is an expectation the standard is to be satisfied and a process of verification is undertaken to confirm compliance. Design standards are typically a combination of prescriptive and outcome-based requirements focusing on the end product. For example, a structural design standard requiring a 9G limit load is an outcome-based requirement. A standard requiring the wing to incorporate at least three wing spars is more prescriptive.



rule, a key finding of the investigation into the Piper Alpha offshore oil rig disaster on 6 July 1988 where 167 workers died as a result of a series of explosions.

Imposition of detailed requirements cannot anticipate all the variances of differing practice, location, organization and size that exist. In fact, prescriptive regulation or over-detailed guidance may at times result in the overall objective actually being compromised. Innovation, on-going improvement and objectivity will be stifled; and the more prescriptive the regulation the more unclear it is who has the responsibility for total safety.³³

MANAGEMENT-BASED

Also known as 'process-based', 'systems-based', 'supervised' regulation, 'meta-regulation' or 'safety-case regulation'.

Management-based regulation focuses on the planning and management activities involved in producing an outcome. It seeks to take advantage of the regulated communities' understanding of the relationship between their behaviours and their outputs, compelling those parties to conduct their own evaluations and find their own control solutions. It has the considerable attraction of providing the most flexibility for enterprises to devise their own least-cost solutions and of facilitating their going beyond compliance with minimum standards. Regulators tend to employ it to address systemic problems rather than individual hazards, most commonly used where there are multiple risk sources and multiple feasible risk controls. Problems where the regulator lacks performance measures, at least short of the dire consequences regulators seek to prevent in the first place – is also a potential candidate for management based regulation.

Management-based approaches hold a number of potential advantages over other styles of regulation. Firstly, they place the responsibility for decision-making with those who possess the most information about the hazards and potential controls. Therefore the actions taken may prove to be less costly as well as more effective than under imposed solutions or outcomes. Secondly, by allowing organisations to make their own decisions, personnel are more likely to view their organisation's rules as reasonable and as a result there may be greater compliance.³⁴

Safety management system (SMS) regulation is an example of management-based regulation. The purpose of an SMS is to manage latent, organisational-type defects. The regulation of SMS in aviation is typically introduced in parallel with existing regulation because it focuses on threats and escalation factors that are difficult to control through traditional prescriptive regulation.

³³ Cullen, W.D. (1990), *The Public Inquiry into the Piper Alpha Disaster*, Her Majesty's Stationary Office, London, para 21.4. Lord Cullen examined the (then) existing UK off-shore and on-shore oil and gas safety systems. One of the major outcomes was a transition to outcome-based regulation.

³⁴ For more information regarding management-based regulation readers are directed to Coglianese, C (2010) 'Management-Based Regulation: Implications for Public Policy' in *Risk and Regulatory Policy – Improving the Governance of Risk*, Organisation for Economic Development, chap 5.



MAKING THE CHOICE

According to the limited academic research in this area there are 2 dimensions to think about when deciding which style to use as presented graphically in Figure 12:³⁵

- (i) The regulator's ability to measure outcomes accurately; and
- (ii) The degree of uniformity across the regulated community.

Management-based regulation is recommended when the sector is varied and where the capacity to assess output is low.

Outcome-based regulation is recommended when the ability to measure outcomes can be established through indicators or metrics.

Prescriptive regulation is recommended when uniformity across the regulated community is high, but the ability to measure outcomes is not possible.

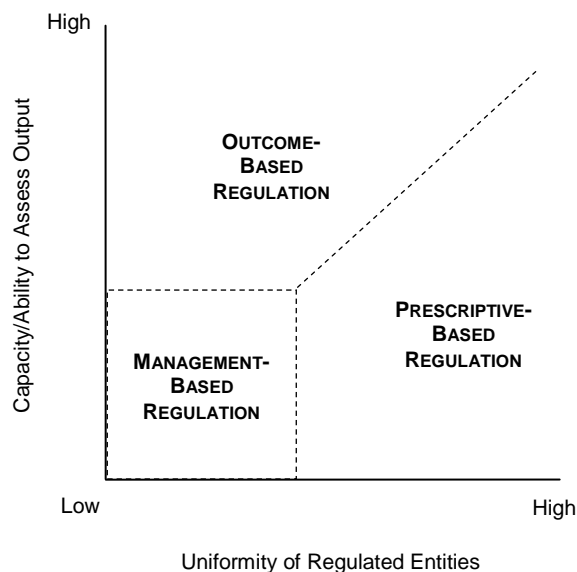


Figure 12. Graphical representation to assist choosing regulatory style.

³⁵ Coglianese, C and Lazer, D (2003) 'Management-Based Regulation: Prescribing Private Management to Achieve Public Goals', RPP-2003-08, Center for Business and Government, John F. Kennedy School of Government.



THE AUSTRALIAN

Piper Alpha lessons still guide safety

PAUL GARVEY THE AUSTRALIAN JULY 06, 2013 12:00AM

FRANK Murray has never been able to forget. Twenty-five years after the diver was among the first to arrive at the burning wreckage of the Piper Alpha oil and gas platform, which remains the deadliest incident in the oil and gas industry's history, Mr Murray still struggles with emotion when recalling the aftermath of the explosion.

"It haunts me every day," he told The Weekend Australian from his home just outside Aberdeen in Scotland.

This weekend is the 25th anniversary of the Piper Alpha disaster, an incident that was a critical turning point in the way the oil and gas industry and regulators approached safety and which continues to shape regulatory policy in Australia.

At a time when much of Australia's established oil and gas infrastructure is starting to age, and when oil and gas activity is on the rise and new companies are entering the industry here, the lessons from Piper Alpha are as relevant to Australia as ever.

Mr Murray was only six months into his job as a diving inspector for Britain's Department of Energy when, on the evening of July 6, 1988, a fire ripped through the Piper Alpha platform off Aberdeen in the North Sea.

The initial blast wiped out the platform's control room and killed those in it. The remaining men on board immediately followed their training, gathering at a muster point in the platform's accommodation unit.

With the fire building in intensity as it continued to be fed with oil and gas, the accommodation unit was cut off from the designated escape routes.

Not that they would have helped - the toxic smoke and heat made it impossible for any helicopters to land on the platform, and the heat incinerated the escape boats.

Those men, following their training as they had been drilled to do, remained trapped within the accommodation module. About two hours after the initial explosion the unit slipped into the North Sea -- by then, all within would have been killed by the extreme heat and smoke.

In all, 167 men lost their lives that night.

The 61 men who survived were all prepared to break with their training. Sensing the futility of the predetermined evacuation plans, they managed to either lower themselves into the water via hoses or simply leapt off the platform into the sea.

Dave Chaplin, who was part of the investigative team that compiled more than 2000 statements from the survivors and witnesses, recalls one of the men who escaped describing how the steel structures of the platform were melting in the heat and dripping into the sea "like water".

The *Tharos*, a large fire-fighting and rescue vessel that was alongside the platform within minutes of the initial explosion, was also repelled by the heat, rendering its fire hoses and gangplanks useless.

When Mr Murray arrived on board the *Tharos* the morning after the disaster, he saw that the paint covering the ship had bubbled and melted.

For six weeks, Mr Murray worked to recover as many bodies as possible. One moment was particularly macabre. During the fire, an emergency response vessel had been dispatched along with two men to help recover survivors. That boat was also lost to the flames.

"We found the boat on the seabed and one of the guys," Mr Murray said. "The guy we found, the heat had been such that his plastic helmet had melted into his head."

For Mr Murray, the tragedy of the disaster was exacerbated by the fact that so many of the victims had been precisely following their training.

"The guys were doing what they were trained to do. They went into what was supposed to be a temporary refuge area, and they died," he said.

The subsequent Cullen inquiry into the disaster was a major turning point in the way governments around the world, including Australia, approached regulation of the oil and gas industry.



Arguably the inquiry's most important finding was the advocacy for a goal-based, rather than prescriptive, approach to safety.

Rather than continue with specific compliance rules, the Cullen inquiry recommended putting the onus for identifying and managing safety risks back on to the oil and gas companies themselves.

Jane Cutler, the head of Australia's National Offshore Petroleum Safety and Environmental Management Authority, told *The Weekend Australian* that the Piper Alpha actually complied with most of the regulations in place at that time. But the regulations had proved inadequate to cope with the series of events that took place.

"Very detailed, prescriptive requirements don't take into account specific situations, they don't take into account the opportunity to improve given the changes in technology and knowledge, and they rely on the regulations addressing all possible circumstances," she said.

"Whereas in a goal-setting regime, the requirement is for people to think deeply and carefully and comprehensively about the risks. It's about less box-ticking, more thinking."

The US, however, has taken steps back towards the prescriptive approach in the wake of 2009's Macondo disaster in the Gulf of Mexico.

Faced with intense public pressure in the wake of the high-profile event, regulators have responded by introducing strict, specific rules to the industry.

Australia, and most of the rest of the world, has continued to stick with the principle of goal-setting.

Mr Chaplin and Mr Murray - both of whom eventually found their way to NOPSEMA, with Mr Murray only recently retiring - have experienced enough in their careers since Piper Alpha to emerge with a view that goal-setting is the right way to approach safety.

"I know the average guy on the street would probably rather have a more prescriptive approach, but I don't think that's right. I'm fully supportive of the goal-setting regime," Mr Murray said.

Mr Chaplin remembers the battles fought to improve safety standards in the industry before Piper Alpha.

"We used to despair at the old prescriptive legislation, because it used to prescribe a bare minimum that they needed to do to comply with the law, and the minimum was all you ever got -- even though the minimum may not be adequate," he said.

The merits of a goals-based regime are only ever one more disaster away from being called into question. "The one thing I can't say, whether it's Montara, Macondo or Piper Alpha, I can't say it will never happen again, or it will never happen here," Ms Cutler said.

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MAXIMISE OUTCOME-BASED REGULATION – IN CONTEXT

...the principle regulations in regard to offshore [oil and gas] safety should take the form of requiring that stated objectives are to be met rather than prescribing that detailed measures are to be taken.³⁶

A BETTER WAY TO REGULATION

In Defence, uniformity among the regulated community continues to reduce and the ability to assess outcomes continues to strengthen. To allow for more flexibility **Defence aviation safety regulators should maximise use of outcome-based regulatory style.**

DRAFTING OUTCOME-BASED SAFETY REGULATION

As outsourcing to industry continues and innovative in-service support arrangements continue to materialise the flexibility available through outcome-based approach must be exploited.

But characterising an already existing regulatory regime as being prescriptive, outcome- or management-based is not particularly helpful either. Better questions are what is, and what should be, the relative roles of each. Neither will function particularly successfully without acknowledging the strengths and benefits of each as well as the context within which they are applied.

The following should be considered when drafting regulation:

- (i) Use outcome-based based regulation when it is possible to specify clearly the required outcome standard, and when there is likely to be different ways of achieving it.
- (ii) Use management-based regulation judiciously, where multiple hazards and threats exist and multiple controls are required.³⁷
- (iii) When considering management-based or outcome-based regulation, consider the capacities of members of the regulated community. Will it be feasible and proportionate to ask them to undertake the required compliance process?
- (iv) Consider the relationship between outcomes, management and prescriptive regulatory elements to ensure they are mutually supportive rather than opposed.
- (v) Finally, regardless of the style chosen, draft regulation simply using plain English.³⁸

³⁶ Cullen, W.D. (1990) *The Public Inquiry into the Piper Alpha Disaster*, Her Majesty's Stationary Office, London, para 21.67 (square brackets added).

³⁷ Management-based regulation is the basis of the 'safety case' regulatory approach used widely in the work, health and safety field and in some other military aviation systems.

³⁸ Office of Parliamentary Counsel (2013) *Plain English Manual* is the recommended guide to drafting regulation.



Box 7: In-Practice – style of the 2013 Defence technical airworthiness regulations

Of the 2013 stock of Defence technical airworthiness regulations (TAREGs), almost half of the engineering regulations (TAREG 3) were prescriptive. The engineering regulation originated in the 1990's from previous internal Defence policy and process guidance. The maintenance regulations developed in the early 2000's (TAREGs 4 and 5) regarded by many as better drafted were almost entirely outcomes based reflecting a more modern approach to regulatory development.

Of interest is comparison with the FAA, where it is estimated that only 20% of the Federal Aviation Regulations (FAR) are outcome-based.³⁹ It is difficult to compare directly however as all of the inherently prescriptive FAA design standards are codified into regulations, whereas TAREGs do not include design standards.

It should be stressed the regulations have been reasonably successful since their introduction as seen in Figure 13. Now with twenty years experience, Defence and industry's interaction with aviation regulation has matured to the point where many of the prescriptive provisions are overly restrictive and burdensome, creating inefficiencies and unnecessary compliance costs for Defence and industry.

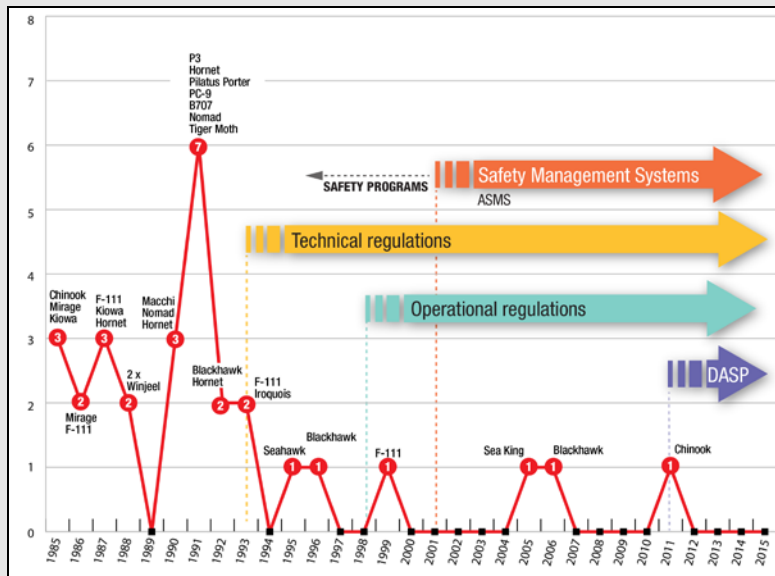


Figure 13. Defence fatal accidents 1985-2014.

³⁹ US Government (2010) *Aviation Safety Report to Congressional Requesters*, Government Accountability Office GAO-11-14, pp 14.



ADDITIONAL CONSIDERATIONS TO IMPLEMENT OUTCOME-BASED REGULATION

Implementation of outcome-based regulation requires supporting mechanisms described elsewhere in this publication and summarised here.

MEASURING COMPLIANCE

Successful outcome-based regulation is dependent on achieving a fair and objective measure of what constitutes compliant. This is addressed in chapter 4 – *Utilise Compliance Proofs*.

LEVEL OF SPECIFICITY

Outcome based does not mean vague, motherhood principle statements. This would result in too much uncertainty. As an example, an independent review of the US Federal Aviation Regulations found that inconsistent interpretation relating to outcome-based regulation was ranked either first or second in problem for the flight standards and aircraft certification processes respectively:

Variations in FAA's [Federal Aviation Administration's] interpretations of standards and certification and approval decisions occurs as a result of factors relating to performance-based [outcome-based] regulation and the use of professional judgement by FAA inspectors and engineers.⁴⁰

Outcomes may be tightly or loosely defined as required. An adequate amount of detail, but no more, is necessary to support outcome-based regulation. This is addressed in chapter 5 – *Ensure Sufficient Prescription*.

EDUCATION

Intuitively duty holders must have a clear understanding of what they must do to comply with their regulatory obligations. It is not surprising that in support of less prescriptive regulation comes increased focus on education and training, addressed in chapter 6 – *Comprehensive Explanation*.

SAFETY INDICATORS

Outcome-based regulation relies not only on the regulator but the regulated entity to monitor and measure the on-going success of their systems and implementation. It is unacceptable to assume that a lack of accidents is proof of success. Both the regulator and the regulated entity will need to establish safety indicators, addressed in chapter 7 – *Safety Indicators*.

⁴⁰ US Government (2010) *Aviation Safety Report to Congressional Requesters*, Government Accountability Office GAO-11-14, pp 14 (square brackets added). GAO was tasked to examine the variation in the FAAs interpretation of standards for certification, approval decisions and overall effectiveness.





3. TAKE A PURPOSEIVE APPROACH

SUMMARY

WHAT

Express the purpose of the regulatory obligation simply and clearly and interpret and apply regulation with its purpose at the forefront of mind.

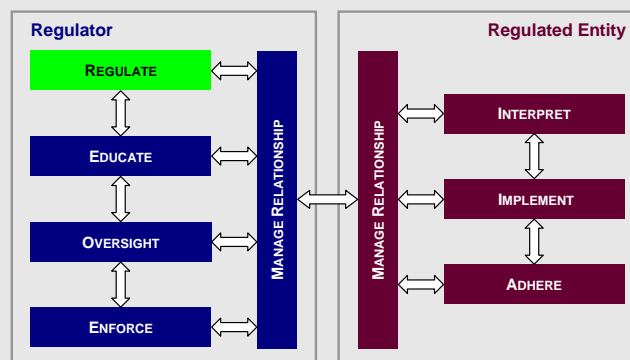
WHY

Increases clarity, protects against tactical, 'black and white' or nonsensical interpretation disputes between members of the regulated community and the regulator.

How

1. Structure regulation so its purpose is clearly apparent, stands alone and places the need for the obligation beyond dispute.
2. Interpret regulation in light of the purpose for which it was enacted.

Purposive regulation is a characteristic of the REGULATE function in the regulatory model.





TAKE A PURPOSIVE APPROACH – IN THEORY

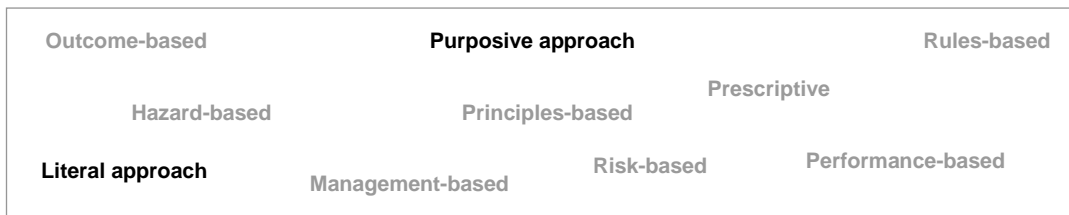
*All rules have a core of settled meaning surrounded by a penumbra of uncertainty.*⁴¹

INTRODUCTION

Certainty of regulation is good regulation. Certainty comes from common understanding of the regulation by those who are obliged to follow it and by those who enforce it. In legislation lawyers spend much of their time interpreting legislation in order to decide how it applies in particular circumstances. The Defence aviation safety regulation needs to be simpler – it is not aimed at lawyers but personnel with a wide range of backgrounds from Defence and industry, including engineers, technicians, logisticians, managers, aircrew, commanders and others.

Typically, without a prior understanding through precedence, or a stated presumption about how regulation should be interpreted, it is natural for people to interpret regulation literally – to the letter. This can result in complications. This chapter looks at a different and often better approach to writing and interpreting regulation.

The terms *literal approach* and *purposive approach* discussed in this chapter originate in the legal fraternity. In this publication the terms are used quite loosely. It is not the intention to explore the legal basis of either approach. Just enough is explained to distinguish between the two and to guide Defence to better aviation regulation.



THE LITERAL APPROACH

Literal interpretation of regulation has a simplicity about it that is attractive – the regulation means what it says. Ordinarily the meaning will correspond with the grammatical meaning of the words in the regulation. Unfortunately literal interpretation suffers from a major defect. The literal approach assumes a word or phrase read in context has only one meaning. But a regulation may have no single, unambiguous meaning.

Over time as different meanings are developed certainty reduces. Uncertainty drives compliance costs and, worse still, deviation from the original intent of the regulation. A subsequent response by the regulator could be to create ‘catch-all’ provisions, intentionally left vague or undefined, to prevent

⁴¹ Hart, H.L.A (1994) *The Concept of Law*, Oxford University Press.



further literal avoidance. This increases uncertainty. Over time this may be solved by reintroducing more prescriptive regulation. A pattern of oscillation of literal interpretation commences between prescriptive regulation and more loosely defined catch-all principles. The best result is a fairly unsophisticated compromise between the two.

THE PURPOSIVE APPROACH

During the 1970's and early 1980's some Australian courts were criticised for handing down decisions based on overly literal interpretation of legislation. As a result the Commonwealth, and later the States and Territories, enacted use of the purposive approach to interpretation, referred to as a shift from 'text to context'.

Writing and interpreting regulation in such a way as to give best effect to its purpose or object is called the purposive approach. Purposive regulation aims to establish common understanding by focusing on the actual intent of the regulation. The success of the purposive approach is based on the premise that unless the purpose is promoted compliance with literal interpretation cannot achieve the declared (and sometimes undeclared) objectives.

IMPLEMENTATION OF THE PURPOSIVE APPROACH

Purposive does not mean the words of a regulation are ignored in favour of its purpose. This would be nonsensical. Rather the purposive approach is used when an attempt to apply the literal approach produces an ambiguity or uncertainty.

Purposive regulation supports any style of regulatory intervention addressed in chapter 2, whether it is management-based, prescriptive or outcome-based regulation.

To understand the purpose of a regulation consideration should be given to any extrinsic material capable of assisting. The strongest piece of extrinsic material is a purpose statement. A purpose statement accompanies, but is not part of, the regulation and ensures its purpose is clearly apparent, stands alone and places the need for the obligation beyond dispute.



TAKE A PURPOSIVE APPROACH – IN CONTEXT

*We don't have any major issues with the regulations,
as long as the regulator interprets them the way we do.*⁴²

A BETTER WAY TO REGULATION

Until now there has been no common maxim or presumption used in interpreting Defence aviation safety regulation. Anecdotally the more experienced organisations tend towards a purposive approach. Those with less experience prefer to take a literal approach. The result is during compliance audits it would be expected to hear disagreements founded on the difference between the literal approach and the purposive approach as follows. Individual A: 'I don't agree with your interpretation, it doesn't say that here on the page'. Individual B: 'I understand what the words say, but the real intent is...'

In order to improve shared understanding and prevent against disputes between members of the regulated community and the regulator the **Defence aviation safety regulation should be drafted and interpreted with a purposive approach.**

HOW

Purposive regulation is achieved in three steps:

- (i) The regulator drafts regulation with an accompanying purpose statement;
- (ii) The regulator communicates its intention to interpret regulation purposively; and
- (iii) The regulator and regulated community interpret regulation with its purpose front of mind.

REGULATOR DRAFTS PURPOSIVE REGULATION

The need to even discuss this chapter has been borne out through experience in Defence where the specific purpose of a regulation is often assumed to be understood but never expressly stated.

Purposive regulation is best achieved by structuring regulation so its purpose is clearly apparent, stands alone and places the need for the obligation beyond dispute. A statement of purpose should therefore accompany each regulation. Individual paragraphs and sub-paragraphs of regulation may also warrant their own statement depending on the circumstances. In the unusual situation where a regulation is not directly related to a hazard, such as an administrative detail, its purpose should still be clearly announced. Otherwise over time the regulated community may tend to recast the regulation to couple with a hazard that was never intended.

⁴² Attributed to the chief engineer of a commercial organisation providing engineering services to Defence in 2012, in response to enquiries as to how the regulations could be improved (name and company withheld).



The purpose statement should be short, no longer than a paragraph. The statement is not a description of the regulation. But rather an explanation of the why and what it aims to achieve. One approach is to construct the purpose from three distinct pieces of information:

- (i) The context;
- (ii) The hazard; and
- (iii) The defence.

For example, using a hypothetical regulation ‘the engineering organisation must enact a review process upon receipt of technical information’. The deconstructed purpose could be as follows.

Context. *Over the life of an aircraft, deficiencies in the original design and degradation due to wear, corrosion and other causes are identified by designers, operators and maintainers of the aircraft.*

Hazard. *The deficiencies and/or the degradation identified may mean the aircraft is no longer as safe as when new or as safe as intended.*

Defence. *This regulation requires engineering organisations to identify, collect, analyse and take action upon pertinent information to ensure the aircraft remains safe.*

These three pieces of information could be reconstructed into the following purpose statement.

Purpose. *Over the life of an aircraft, deficiencies in the original design and degradation due to wear, corrosion and other causes are identified by designers, operators and maintainers of the aircraft. The deficiencies and/or the degradation identified may mean the aircraft is no longer as safe as when new of as safe as intended. This regulation requires engineering organisations to identify, collect, analyse and take action upon pertinent information to ensure the aircraft is safe.*

Establishing the purpose of existing regulation may be time consuming. Disagreement amongst regulatory staff indicates a variation in understanding of the existing rule. This should be expected and worked through. The result will be better regulation and a common understanding.

REGULATOR COMMUNICATES PURPOSIVE INTENT

All involved in the regulatory process should have a common understanding of regulatory interpretation. The regulator should widely communicate its intention to interpret purposively.

REGULATOR AND REGULATED INTERPRET PURPOSIVELY

Interpreting regulation starts with a literal interpretation. If the words of a regulation are clear and free from ambiguity there is no need to consider its purpose any further. If the words of the regulation are vague and ambiguous then refer to the purpose statement which accompanies the regulation closely to interpret the regulations’ meaning. If no statement exists refer to other extrinsic material such as guidance, advisory circulars or other documentation issued by the applicable regulator. The ultimate aim here is to put oneself in the shoes of the regulation drafter – to consider what knowledge they had, and what regulatory objective they had in mind.



Box 8: In-practice – some purposive examples

The following examples are from the 2014 TAREGs. The square brackets have been added to deconstruct the purpose statement into the three recommended pieces of information to be included.

TAREG 3.5.11. Special Technical Instructions

a. Each applicant ... must establish a Special Technical Instruction (STI) management system for issue of those design changes and Authorised Maintenance Data whose urgency cannot be satisfied by other types of implementing instructions.

Purpose. [Background] An essential element of any airworthiness management system is the ability to promulgate urgent safety related information to aircraft operators and maintainers. [Hazard] A subset of this information concerns technical issues requiring inspection, test, installation, repair or replacement actions that, if not actioned in a timely manner, could result in an unsafe condition. [Defence] This TAREG requires that a timely system is in place to prepare, release, receive and action urgent technical information necessary for the continued safe operation of an aircraft or configuration item.

TAREG 3.5.14. Management of Type Design Data

a. Each applicant ... must establish a system for management of Type Design data ... to ensure only current and relevant data is used for design activities.

Purpose. [Background] To develop a design change it is important to ensure that the developer is using current and approved Type Design Data. [Hazard] If a design change is incorporated into an aircraft that does not represent the configuration described by the Type Design Data used in the design's development, the design assumptions, specifications and calculations may all be incorrect, and hence the design change – if implemented – could be unsafe. [Defence] This TAREG requires that only current and approved Type Design Data is used for each design's development.

TAREG 2.2.2. Issue of Type Certification Recommendation

a. The DAR must submit to the TAR copies of ... [various documentation]:

Purpose. [Background] Type certification activities for an aircraft type occur over an extended period, and the process produces a large amount of documentation. [Hazard] If this documentation is not properly collected, collated, analysed and presented in a way that can be understood by decision makers, an unsafe design may be accepted. [Defence] This TAREG requires that persons seeking a TAR recommendation for issue of a type certificate to collect, collate, analyse and present information necessary to show the compliance of a type design against applicable airworthiness standards.







4. UTILISE COMPLIANCE PROOFS

SUMMARY

WHAT

Define verification criteria against which to assess compliance.

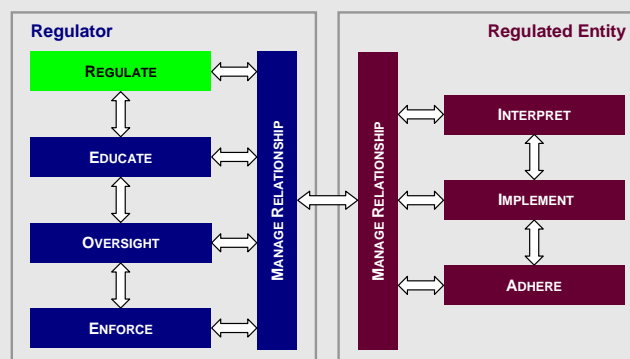
WHY

Compliance proofs increases certainty as to compliance requirements, resulting in minimised compliance disputes and 'gold plating'.

How

Define specific, measurable, demonstrable and repeatable verification requirements for each regulation to support unambiguous compliance determination.

To utilise compliance proofs is a characteristic of the REGULATE function in the regulatory model.





UTILISE COMPLIANCE PROOFS – IN THEORY

INTRODUCTION

What constitutes compliance? The potential benefits of outcome-based regulation can be offset by uncertainty in the absence of clearly identified standards for compliance obligations. Furthermore, where combinations of regulatory styles are used, clarification is needed on whether regulatory compliance is achieved through inspection of the process or the outcome.

Successful enforcement is dependent on achieving a fair and objective measure as to whether the regulated entity has achieved a particular outcome. This can be difficult to achieve. Quantitative measures are only ever proxies for quality of behaviour, can skew activities away from the achievement of substantive compliance and are themselves open to creative compliance. As a result organisations can 'hit the target but miss the point'.

COMPLIANCE PROOFS

Compliance proofs are specific, measurable, demonstrable and repeatable test points for each regulation to support unambiguous compliance determination:

- Compliance proofs are explicit requirements against which evidence is assessed to determine compliance.
- Proofs reflect the intent of the regulation but drafted in words useful to assess compliance.
- In most cases all compliance proofs must be met to prove compliance against the regulation.
- Compliance proofs are comprehensive. More proofs cannot be added later – there should be no need to unless an error was made in establishing the proofs in the first instance.

Satisfying compliance proofs is mandatory. But proofs are not 'regulatory' because they are drafted at regulatory staff, although they will provide the regulated community with the expectations that the regulator is looking for. Nevertheless if a discrepancy exists between a regulation and the corresponding compliance proofs, the regulation shall always take precedence and the compliance proof shall be disregarded to the extent it conflicts with the regulation.

To explain let's turn to an example from the *Defence Force Disciplinary Act 1982*. The DFDA includes essential characteristics that define 'success'. This is the equivalent of compliance proofs.

DFDA section 24 (1):

A defence member who is absent without leave is guilty of an offence.

The following proofs set out exactly what must be shown to be true in order for the regulation (the charge) above to be satisfied. To gain a conviction under this charge, the prosecutor must satisfy all of the proofs:



- a. that the accused was a defence member;
- b. that the accused was absent from his or her unit (or ship etc) as specified; and
- c. that the absence was without authority of anyone competent to give the accused leave.

The proofs listed here in no way suggest what evidence the prosecutor may use to satisfy them, they simply state the outcome that must be shown. This is the difference between proofs and evidence. Where possible compliance proofs should not indicate what evidence must (or even may) be produced. If they did, the regulation has instantly limited the regulated entity for no good reason.

The following 4 step graphical representation depicts compliance proofs in action.

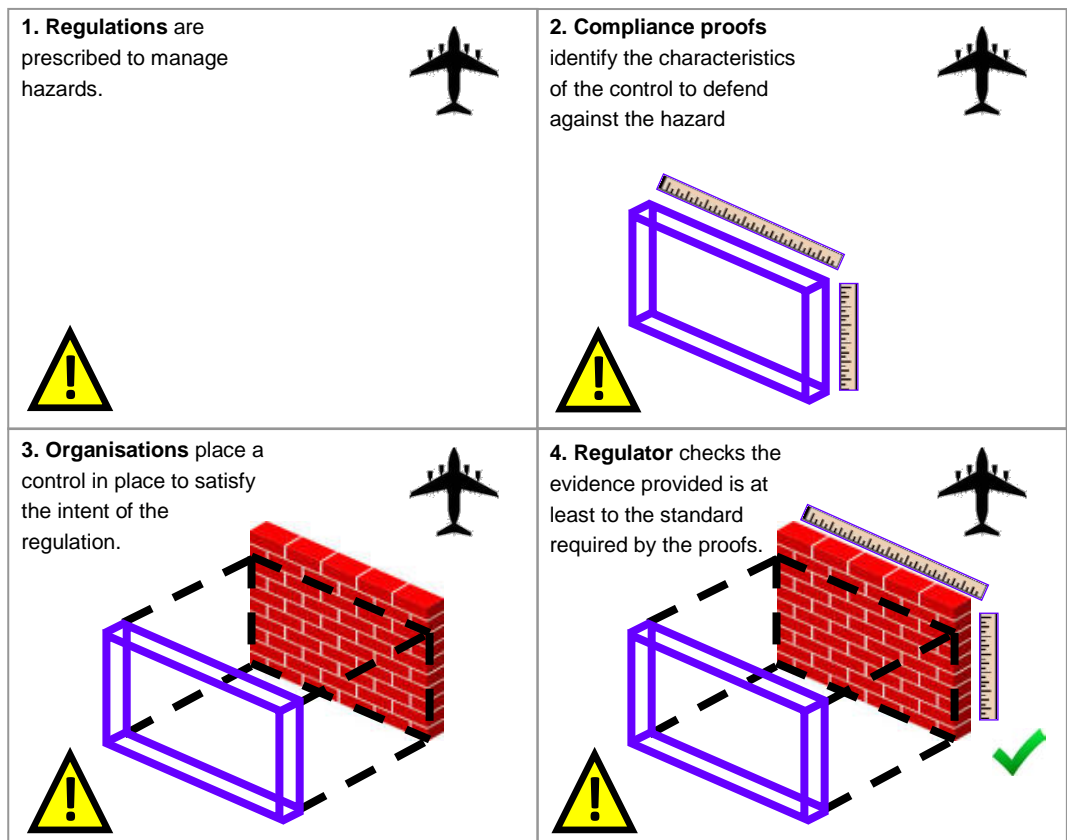


Figure 14. Graphical representation of the purpose of compliance proofs.



SYSTEMS ENGINEERING ANALOGY

For readers familiar with the field of systems engineering, compliance proofs are similar to verification requirements. Recapping, in systems engineering there are three types of requirements:

- Functional requirements – what is the system to do?
- Performance requirements – how well does the system do it?
- Verification requirements – how do we check the system does what it is meant to?

Function and performance are important parts of a requirement. However the requirement is not complete until we know a way of verifying that function and performance. In systems engineering it is good practice to write verification requirements at the time of developing functional and performance requirements. It is also a good test of the requirements itself. If you do not know how to confirm the system has met the functional and performance requirements, chances are the requirement is not well drafted.

This is similar to regulation. There is no point in drafting a regulation when compliance can never be verified. The system engineering analogy is to think of regulation as the functional and performance requirements and the compliance proofs as the verification requirements.

COMPLIANCE PROOFS ORIGINATE IN LOGIC

Verifying compliance against individual regulation can result in one of three conclusions:

- (i) Compliance;
- (ii) Non compliance; or
- (iii) Cannot be determined.

The process involved in reaching a conclusion will always involve discretion and judgement on the part of regulatory staff. But it should be a logical process. The origin of compliance proofs lie in the theory of logic, specifically deductive reasoning.

DEDUCTIVE REASONING

Deductive reasoning is a logical process of reasoning from one or more statements (called premises) to reach a logically certain conclusion. The process links premises with a conclusion. A deductive argument asserts that the truth of the conclusion is a logical consequence of the premises. Premises are either true or not based on evidence. If and only if the premises are true then the conclusion must be true.

The truth of the conclusion depends on the truth of all of the premises. If one of the premises is not true, the truth of the conclusion is no longer guaranteed. In deductive arguments the ‘burden of proof’ is shifted from the conclusion to the premises.



An example of deductive reasoning follows. This example consists of two premises:

Premise 1: *Fred is a dog.*

Premise 2: *All dogs have four legs.*

For a moment, assume that both of these premises are true. If both are true then the conclusion must be that:

Conclusion: *Fred has 4 legs.*

In deductive reasoning the truth of the premises guarantees the truth of the conclusion. So the conclusion could only be rejected on one or both of the following grounds: (i) that Fred was not a dog; or (ii) that all dogs do not have 4 legs.

PREMISES

Premises are either:

- (i) Generally agreed on without the need for further consideration;
- (ii) Shown to be valid by supporting evidence; or
- (iii) Unsupported assertions.

EVIDENCE

Evidence is an alleged fact which supports a premise. How strongly the evidence supports the premise will depend on subjective belief. In the Fred the dog example you either believe the premises or you don't based on the available evidence. If no evidence is provided then it is less likely that you will believe the premises. One quasi-rational approach to this question is to evaluate the 'likelihood' of the claim, assuming the evidence is true. If you don't believe the premise then ask for more evidence.

DEPENDENT VS INDEPENDENT PREMISES

In deductive reasoning theory, the premises (compliance proofs) must be treated as a set. They are a set of **dependent** premises. If the logical chain is complete then they actually prove the conclusion. If one premise is removed and the logical chain is broken then they no longer prove the conclusion.

COMPLIANCE PROOFS SUPPORT UNITY OF PURPOSE

A piece of writing can usually perform only one purpose well. If the need arises to achieve different purposes for different audiences, a better way is to write two pieces each directed at the intended audience. This is the aim of compliance proofs. The regulation is directed at the regulated community. Compliance proofs are directed at regulatory staff. Both regulation and compliance



proofs are intended to be read by both groups but this delineation acknowledges the two different audiences and aims to achieve a single unity of purpose as depicted here:

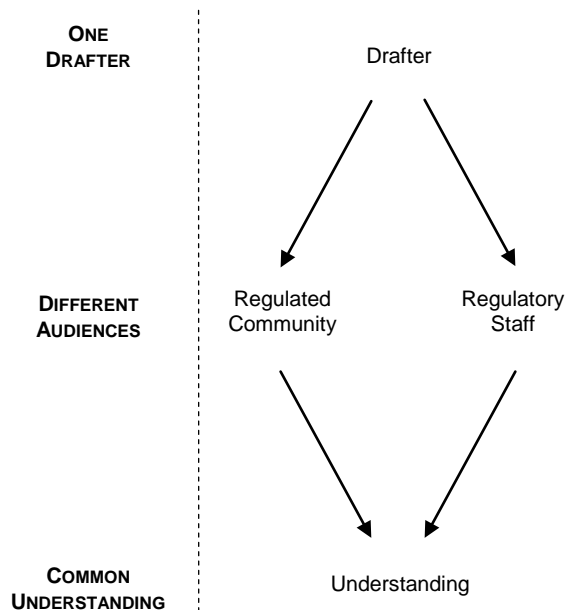


Figure 15. Compliance proofs aim to bring the two audiences of the regulation to the same understanding.

COMPLIANCE PROOFS AND EVIDENCE

In regulatory language the regulation is the conclusion, the compliance proofs are the premises, and compliance evidence is the evidence to support the premises. If each compliance proof is true, then compliance with the regulation is achieved. The truth of each compliance proof is determined by examining compliance evidence.

It is important to distinguish between compliance proofs and compliance evidence. Evidence is not proof. It satisfies proofs have been met. Compliance evidence is anything a regulated entity produces to demonstrate a compliance proof is met. Existence of compliance evidence does not prove compliance. The assessment of that evidence by regulatory staff against the proofs determines compliance.



UTILISE COMPLIANCE PROOFS – IN CONTEXT

*The inspector has formed the opinion that the workplace does not comply. That must mean that the inspector has in mind what compliance would look like. I want the inspector to tell me here and now what needs to be done, so I can get on with doing it.*⁴³

A BETTER WAY TO REGULATION

Many lawyers spend much of their time interpreting legislation in order that they can decide how it applies in particular circumstances. Interpretation of legislation is not achieved by merely reading the text. The common law, previous court interpretations of that legislation and interpretations made in relation to aspects of other legislation (such as the meaning of particular terms) must also be considered. Correct interpretation is never really tested until a challenge arises in a court.

Interpretation of Defence aviation safety regulation is not supported by a body of precedence. Furthermore the regulation needs to be understood and applied by practitioners, not lawyers. As a result, the regulations need to be all encompassing and aimed at individuals with a wide range of backgrounds.

With this in mind, the **Defence aviation safety regulators should utilise compliance proofs**. The aim of compliance proofs is to set specific, measurable, demonstrable and repeatable test points for each regulation to support unambiguous determination of compliance.

THE OVERSIGHT PROCESS

The oversight process will always involve discretion and judgement on the part of regulatory staff. But it should be a logical process. The logic is as follows:

1. The regulated entity is asked to show compliance against the applicable regulation during initial certification or ongoing audit.
2. The entity provides evidence to support their claim that they are compliant with the applicable regulation.
3. Regulatory staff assess the evidence provided against each compliance proof and make either of two determinations:
 - a. The compliance proof is met when supported by the evidence provided.
 - b. The compliance proof is not met even when supported by the evidence provided and to say otherwise is an unsupported assertion.

⁴³ The manager of a small business subjected to a safety audit as quoted in Maxwell, C. (2004) *Occupational Health and Safety Act Review*, Victoria.



4. Regulatory staff may need to seek further evidence from the regulated entity. If no further evidence is available to support satisfaction of the compliance proof, that compliance proof is assessed as unsupported and the argument for compliance with the regulation is invalid. Appropriate enforcement action would then be initiated.
5. Where all compliance proofs are met the regulated entity is assessed compliant with the regulation.

Compliance proofs do not imply that the regulated entity must in some way take on a burden of proof to demonstrate compliance with the proofs. Compliance proofs are written for regulatory staff. The regulated entity would be expected to note the proofs but they do not necessarily need to use them as a checklist.

DRAFTING COMPLIANCE PROOFS

Drafting regulation with compliance proofs means doing the following:

- (i) Ensure the regulation is directed at the correct audience. Regulation is aimed at those obliged to follow it – the regulated community. Compliance proofs are for regulatory staff.
- (ii) In order to satisfy a regulation each and every proof would usually need to be satisfied unless indicated otherwise. There should be nothing undocumented that regulatory staff can refer to in order to determine noncompliance when all compliance proofs are satisfied.
- (iii) It may be helpful to parse the language of compliance proofs into standard format to ease understanding, such as questions requiring a yes/no assessment.
- (iv) In existing regulations drafted without the use of compliance proofs, the proofs may already exist in the regulation as sub-paragraphs and sub-sub-paragraphs, and may simply require redrafting.
- (v) Compliance proofs are more detailed and obvious to draft where the regulation is outcome-based and not highly detailed. A detailed prescriptive regulation may not warrant any compliance proofs as it is self evident. In such cases there would only be one compliance proof by restating the regulation in the correct parsing.
- (vi) If compliance proofs are developed based on firm logic they should not need to be amended or added to in future.

PREFERRED SOLUTIONS

Preferred solutions are neither compliance proofs nor compliance evidence. They are a description of a solution that would satisfy the proofs and therefore the regulation. The concept of the preferred solution is a practical way of assisting the regulated community however it is often incorrectly treated as being mandatory. Therefore it is recommended to minimise use of the term 'preferred', instead focussing on examples of acceptable evidence against each compliance proof.



ACCEPTABLE MEANS OF COMPLIANCE

The concept of acceptable means of compliance (AMC) remains valid together with compliance proofs. An AMC is an accepted solution. Like above, it is a description of a solution that is regulatory compliant. The solution is compliant because it has been shown to have been compliant before against the compliance proofs. Therefore where an AMC solution is utilised it should not be necessary to use the compliance proofs to determine compliance. Instead it would require comparison of the solution against the AMC to ensure no significant deviations were present. Where deviations were apparent and the AMC has not been followed exactly, regulatory staff would need to go back to the compliance proofs to determine compliance.



Box 9: In-practice – TAREG 2.6.5.a ‘Notification of Unairworthy Conditions’

TAREG 2.6.5.a. (As of April 2014) *The DAR [Design Acceptance Representative] must immediately notify the TAR whenever an aircraft has, or is likely to be operated in an unairworthy condition. The DAR’s notification must include the:*

1. Details of the source of information;
2. Potential risk to safety;
3. Number of aircraft affected;
4. Proposed action to rectify the unairworthy conditions; and
5. Potential impact on operations.

EXAMPLE

Section 3 Chapter 2 Guidance. *The DAR is responsible for notifying both the TAR and the Operational Airworthiness Authority (OAA) whenever an aircraft type has a condition or defect which is unairworthy in accordance with the regulations. This includes conditions that although they may not be directly unairworthy, may involve a substantial restriction in operations or operational capability.*

To write compliance proofs for this regulation requires a rewording and removal of the criteria in the regulation and reparsing into proofs.

Possible Regulation. *The DAR must notify the TAR within a reasonable timeframe whenever an aircraft has been, or likely to be operated in, an unairworthy condition.*

Compliance Proofs

CP1. Instances of unairworthy conditions occurred during the period. (Yes/No)

CP2. The DAR notified the TAR in each instance. (Yes/No)

CP3. The time taken to notify the TAR was reasonable in the circumstances, such that the TAR was not unduly delayed from making informed decisions. (T/F)

Compliance Evidence

Examples of evidence to support each proof could be:

1. Collate the number of unairworthy conditions experienced by the platform in question either through a declaration by the SPO, independent count of risk assessments etc.
2. Correlate the number of unairworthy conditions against number of TAR notifications.
3. Advice from TAR.

Note. The April 2014 TAREG example includes specific detail about the content of the notification. Treatment of that detail is not addressed in this example.







5. ENSURE SUFFICIENT PRESCRIPTION

SUMMARY

WHAT

Decompose outcomes into constituent parts so that obligations are comprehensively specified and ambiguous principles are avoided.

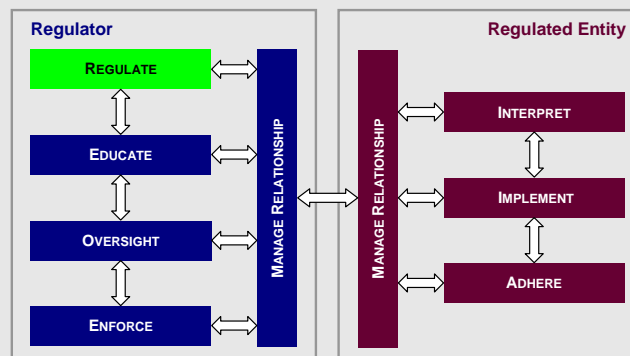
WHY

Enable clarity and certainty of outcome-based regulation protecting against interpretation and compliance disputes.

How

Decompose outcomes and compliance proofs into sub-outcomes and sub-proofs so that obligations are comprehensively specified.

Sufficient prescription is a characteristic of the REGULATE function in the regulatory model.





ENSURE SUFFICIENT PRESCRIPTION – IN THEORY

INTRODUCTION

The degree of specificity is another, and different, characteristic of regulation that should be manipulated to achieve the best regulatory outcome. Highly specific regulation is precise and detailed. In comparison less specific regulation uses principles and more general language. The degree of specificity may be considered along a continuum as depicted in Figure 16. Unspecific language lies at one end and is referred to as principles-based regulation. Highly specific language lies at the other end and is referred to as rule-based regulation. These descriptions only make sense in relative terms. There is no such thing as entirely principles-based regulation and likewise for rules. Each form has advantages and disadvantages.

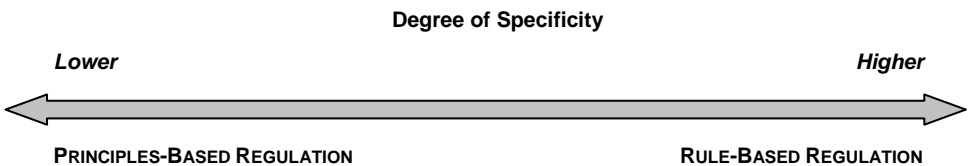
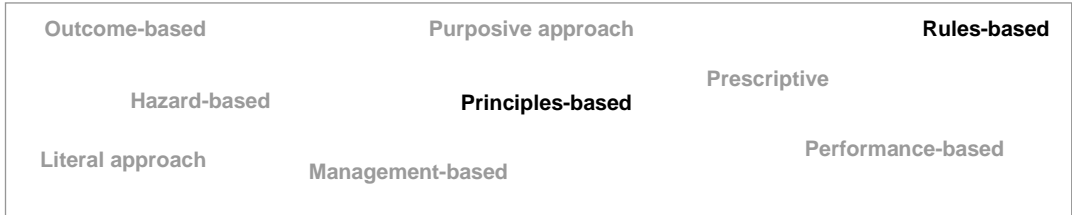


Figure 16. The degree of specificity is another, different characteristic of regulation.

Use of ‘prescriptive’ in the chapter title should not be confused with its use in chapter 2 which refers to a style based on its timing of intervention, rather than level of detail.⁴⁴ The level of specificity, whether detailed or principles-based, is compatible with any intervention point (whether management-based, prescriptive or outcome-based).



⁴⁴ Specificity means the state of being specific or precise in detail. Accordingly, the title of this chapter could have been, rather awkwardly, ‘sufficient specificity’.



CONTRASTING TWO EXTREMES

PRINCIPLES-BASED REGULATION

Principles-based regulation means relying on high-level broadly stated principles to set the standards by which members of the regulated community must conduct their business. They set the express fundamental obligations to be observed. Principles are largely behavioural based and qualitative. Principle-based terms include 'fair', 'care', 'diligence' and 'reasonable'.

An example of a principle-based regulation is from ICAO Annex 8 – *Airworthiness of Aircraft* which stipulates that 'details of design and construction shall be such as to give reasonable assurance that all aeroplane parts will function effectively and reliably in the anticipated operating conditions'.⁴⁵

The benefits of principles-based regulation include:

- Offers more flexibility in determining how to comply – particularly beneficial for more knowledgeable entities ('stop telling me what to do');
- Tends to focus on the purpose where otherwise the purpose can be obscured by the detail;
- More difficult to manipulate, reducing 'creative compliance';
- Can simplify the regulatory language, allowing focus on the important aspects;
- Provides a basis for open dialogue between regulators and the regulated community, facilitating a co-operative and educative approach to oversight rather than a box ticking approach.

RULES-BASED REGULATION

Rules are more specific and precise in their requirements. They tend to be lengthier with sub-paragraphs and sub-sub-paragraphs, relying less on guidance material as more detail is within the regulation itself.

Rules can never provide an airtight seal against unimagined or unimaginable contingencies. They can never be infinitely specific. Nevertheless the benefits of rules over principles include:

- Gives comfort to those regulated of knowing their obligations as compared to principles which may not be sufficiently certain – particularly beneficial for less knowledgeable entities ('just tell me what to do').
- Less reliance on guidance material to explain what is required, as opposed to principles where in an attempt at creating consistency a proliferation of internal guidance amongst regulatory staff may become at odds with the regulation itself.

⁴⁵ ICAO (2010) *Annex 8 to the Convention on International Civil Aviation—Airworthiness of Aircraft*, 11th edn, para 4.1.



- Less open to regulatory creep – obligations are less likely to expand under rules as they are more tightly defined, unlike principles where the intent can change over time.

AIM OF SUFFICIENT PRESCRIPTION

Both of the above approaches share the same goal – to achieve good regulation. Two of the most important criteria for good regulation are certainty and flexibility. Rules tend to achieve more certainty. Principles tend to achieve more flexibility. The optimal condition therefore is to maximise the combined benefits. This should be expected to occur somewhere between the two extremes.

CERTAINTY AND FLEXIBILITY

Rules tend to achieve certainty but only up to a point. One must recognise that complete certainty is rarely attainable. In seeking to provide certainty through an ever-increasing proliferation of detail, not only will any level of flexibility be lost but certainty can decrease as organisations are never sure if they have followed all the guidance that the regulator might deem to be relevant. Both regulator and regulated therefore need to exercise self-restraint: on those regulated in asking for ever greater predictability, and on the regulators' part for trying to provide it.

Whether a regulation is certain depends on understanding.⁴⁶ Understanding depends not only on the level of detail provided in the regulation and guidance but whether all those applying the regulation agree on what it means. In situations of uncertainty, humans tend to draw on past experiences. This means that experience, not only competency, should be taken into account when considering the level of detail to be included in a regulation.

For some people, principles have an uncomfortable vagueness about them and leave too much discretion to those regulated. Even those begging for freedom from the regulator's detailed grasp may not have the time or the inclination to engage in development of solutions to principles. As a result principles-based regulation is often supported by more specific guidance that may have all the characteristics of rules.

CONTEXT

Finally, all organisations have a preference as the extent to which rules or principles are better suited to their culture. So to say principles are too vague makes sense only against a background of more specific regulation. Likewise to say that a rule is too constraining makes sense only against a background of an existing precedence for principles. No way is the right way, it is all about context.

⁴⁶ It is useful to distinguish between certainty and predictability. Certainty with respect to regulation means a common understanding within and between the regulator and the regulated. Predictable refers to the regulatory response, and means the regulator will always respond to similar situations in similar ways.



ENSURE SUFFICIENT PRESCRIPTION – IN CONTEXT

A BETTER WAY TO REGULATION

Regulation is rarely congruent with its purpose – it is either over inclusive or under inclusive. Utilising sufficient prescription aims to get the balance right by taking advantages of both principles and rules-based approach. The goal is a practical, pragmatic response to the competing needs of clarity, flexibility, simplicity and certainty. With this in mind **Defence aviation safety regulation should be drafted with a sufficient level of prescription, but no more.**

How

A sufficient level of prescription may be achieved by:

- (i) Appreciating that aiming for more precision in the regulation can ultimately create more uncertainty.
- (ii) Ensuring the regulation is directed at the correct audience. The regulation should be written to the regulated community. If additional detail is considered necessary to assist regulatory staff, consider incorporating this detail into the compliance proofs.⁴⁷
- (iii) Ensuring the regulation and compliance proofs are congruent. Compliance proofs should link to the regulation and must not create new regulatory requirements.

GUIDANCE

The choice of how specific or not to make a regulation should be made on a case by case basis. The general principle is to be as precise as required but no more. The following factors should be considered to inform a decision:

- As the complexity of regulation increases, certainty moves from being positively associated with specificity to being negatively associated with specificity.
- Perform a stock take of the regulations on occasion, and determine the most rule-based and the most principles-based regulation in the set. Use as a yardstick or reference.
- When the type of hazard to be regulated is simple and stable specific regulation creates higher certainty than principles.
- With complex actions in changing environments principles are more likely to enable certainty.
- Principle-based regulation is likely to see fewer exemptions than detailed prescription. A continuing trend of requests for exemption may indicate a regulation more detailed than it

⁴⁷ Compliance proofs are discussed in chapter 4.



needs to be. Be aware that many members of the regulated community avoid seeking exemptions unless considered critical because the process itself can be time consuming and uncertain.

- The degree of specificity depends on the choice about how much discretion a regulated entity should have.
- The regulation should be drafted so it is possible for a regulated entity to comply even without meeting any of the acceptable means of compliance (AMC).
- AMC can sometimes work too well in the sense that regulatory staff sometime seem unprepared to deviate from the written guidance. AMC and other guidance should never be mandatory or considered a default position. It is but one means that has proven successful in the past and documented purely for the benefit of others rather than as an obstacle to alternatives.
- Many in the regulated community will treat guidance as binding, particularly the less knowledgeable entities, unless it is convenient for them not to do so.
- If amending existing regulation, base the changes on the general understanding of the existing regulation rather than the way it is actually worded. In other words when determining a new level of precision avoid using the existing regulation as a yardstick – use what the regulated community understands it to mean.
- Beware of adopting wording directly from other regulators as their level of specificity is sometimes dictated by factors that are not relevant to the regulatory regime at hand. For example, EASA regulations are drafted in a manner such that they can be translated into any language of the European Union.







6. PROVIDE COMPREHENSIVE EXPLANATION

IN SUMMARY

WHAT

Implement a comprehensive and ongoing education program on aviation safety regulation.

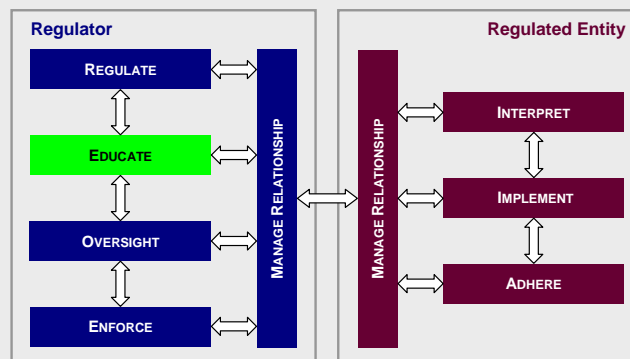
WHY

Regulations and guidance material alone are never enough to convey intent. A comprehensive program of explanation contributes to consistent safety performance and protects against conservative application inherent with poor understanding of regulation.

How

Implement a comprehensive and ongoing education campaign to explain the regulations.

Comprehensive explanation is a characteristic of the EDUCATE function in the regulatory model.





PROVIDE COMPREHENSIVE EXPLANATION – IN THEORY

*Effective regulation is not just about carrots and sticks, it's also about sermons.*⁴⁸

INTRODUCTION

Comprehensive explanation of the regulations to both regulatory staff and the regulated community is important. Only through extensive regulatory conversations can a shared understanding be achieved about the objectives of the regulatory regime, about respective roles and responsibilities, and about interpretation and application of the regulatory requirements.

Rather than adopting a solely punitive approach regulators need to develop a more educative and advisory approach, one in which it is prepared to validate decisions of members of the regulated community in certain circumstances. In other words to give straight answers to straight questions.

Equally, regulatory staff need to be able to answer those straight questions. Staff that lack the relevant technical knowledge will be incapable of enforcing regulation effectively, irrespective of what regulatory style is adopted.

APPROACH

Comprehensive explanation is characterised by educative material that is comprehensive and relevant. It is not the intention of this guide to delve into the depths of education theory. The key point here is to acknowledge that a regulator has an educational responsibility to enable the regulatory regime to operate most effectively.

The regulator may conveniently categorise the audience into two distinct groups:

- (i) **Regulated Community.** The approach taken in this chapter to providing comprehensive explanation to members of the regulated community is guided by the ICAO State Safety Programme requirements on civil aviation regulatory authorities.
- (ii) **Regulatory Staff.** The approach to comprehensive explanation of regulatory staff is also guided by the ICAO State Safety Programme requirements but also by the ICAO *Safety Oversight Manual*.

COMPREHENSIVE EXPLANATION FOR REGULATED ENTITIES

A regulator's role is not only to prescribe regulations, but explain, in various formats what they mean. The aim is to help the regulated community understand the regulations for their own context.

⁴⁸ Unknown.



The regulator should provide education and promote awareness of safety hazards and risks to the regulated community. The regulator should have appropriate communication mediums, in addition to the regulation itself, to facilitate understanding and implementation of regulatory obligation by those regulated. This may be an integrated medium for all those regulated or dedicated educative channels. The basic content should include explanation of the regulations and guidance material. Without going into further detail here, this may involve:⁴⁹

- (i) Establishing processes to communicate regulatory-related information to the regulated community.
- (ii) Developing guidance material on implementation of regulatory obligations.
- (iii) Establishing the means to communicate safety-related issues through mechanisms such as newsletters, bulletins or websites.
- (iv) Promoting exchange of safety information with and amongst different organisations and the regulator.
- (v) Facilitating regulatory training for the regulated community where appropriate.

COMPREHENSIVE EXPLANATION FOR REGULATORS

A regulator should provide internal training, foster awareness and encourage two-way internal communication of safety-relevant information to achieve an effective and efficient regulatory regime. This may involve:⁵⁰

- (i) Developing internal training policy and procedures.
- (ii) Developing a training programme for relevant staff.
- (iii) Developing means of communicating safety related information within the regulator's office.

As the regulatory system evolves, new processes, procedures or regulations may come into effect or existing procedures may change. To ensure these changes are effectively understood and implemented by all personnel involved in regulatory roles it is vital that training and communication remain as ongoing activities. For more information see the ICAO *Safety Oversight Manual*.⁵¹

⁴⁹ ICAO (2013) *Safety Management Manual* Doc 9859 3rd edn, SSP Element 4.2 'External training, communication & dissemination of safety information', para 4.4.19.

⁵⁰ Ibid, SSP Element 4.1 'Internal training, communication & dissemination of safety information', para 4.4.18.

⁵¹ ICAO (2011) *Safety Oversight Manual* Doc 9734 Part B 2nd edn, chap 8 'Training programme of the regional safety oversight organization'.



PROVIDE COMPREHENSIVE EXPLANATION – IN CONTEXT

A recurring theme in discussions with stakeholders was the lack of understanding of the airworthiness management system.⁵²

A BETTER WAY TO REGULATION

For a non-prescriptive regulatory regime to function successfully, members of the regulated community must have a clear understanding of their obligations. In support of less prescriptive regulation comes increased focus on education and training. **Defence aviation safety regulators should implement a comprehensive and ongoing education program on aviation safety regulation.** The alternative is to allow less effective or unnecessarily conservative implementation, potentially resulting in the bare minimum or excessive compliance cost.

To satisfy both the regulated community and regulatory staff there needs to be a standard suite of regulatory training material, a structured way of delivering it and a governing administration processes. This can be achieved with the application of resources and focus on aligning regulatory education to the Defence Training Model (DTM) and Australian Qualifications Framework (AQF). Furthermore, less formal modes of explanation through the genuine engagement processes are explained in chapter 10.

Some examples of ways to explain regulation are in the following break-out boxes. Detailed explanation of how to provide a comprehensive education program is beyond the scope of this publication.

⁵² Smith, N.A. (2007) *ADF Airworthiness Management System Review*, unpublished.



Box 10: In-practice – use of web-based training

Web-based training, once established provides an easy and cost-effective delivery of training. Another advantage is the flexibility it provides for trainees in terms of not having to accommodate various schedules or physical locations.

An example is the Defence Airworthiness online course. The course provides an overview of the Defence airworthiness management system, including its scope, key appointments, airworthiness regulatory system, airworthiness instruments and the key reference publications. The course is relevant to anyone interested in or directly involved in Defence aviation and is a prerequisite for some specific appointments and courses across Defence.





Box 11: In-practice – use of interactive electronic manual technology

Another approach to comprehensive explanation of regulation is through the utilisation of interactive electronic manual technology. Comprehensive explanation was described earlier as characterised by educative material that is comprehensive and relevant. An interactive regulatory manual is based on the same technology used for interactive electronic technical manuals. The aim would be to compress the volumes of regulation, guidance material, previous decisions and other supporting material into a single source enabling readers to easily find relevant information far more rapidly than in paper manuals.

With a comprehensive database of information, an interactive electronic manual technology could:

- State the regulations;
- Explain the regulations (provide guidance material);
- Provide further explanatory material (audio, video, background explanations);
- Provide examples of how the regulations have been successfully satisfied (acceptable means of compliance);
- Explain what regulations apply in a particular context (smart filtering);
- Support self-assessment of compliance (provide compliance proofs);
- Support demonstration of compliance to regulators (create expositions);
- Explain what regulatory staff determined and what needs to be done for compliance (audit reports);
- Broadcast approvals under the regulations (create certificates);
- Help those regulated ask questions (of the regulators and perhaps even each other);
- Answer questions (database of previously asked questions linked to particular regulations or topics);
- Confirm potential compliance approaches will satisfy regulations (provide determinations);
- Assist in managing acceptable noncompliances (exemptions);
- Provide channel for feedback and suggestions (publication improvement request function)







7. UTILISE SAFETY INDICATORS

IN SUMMARY

WHAT

Utilise a wide-range of indicators for continuous monitoring and assessment of safety performance.

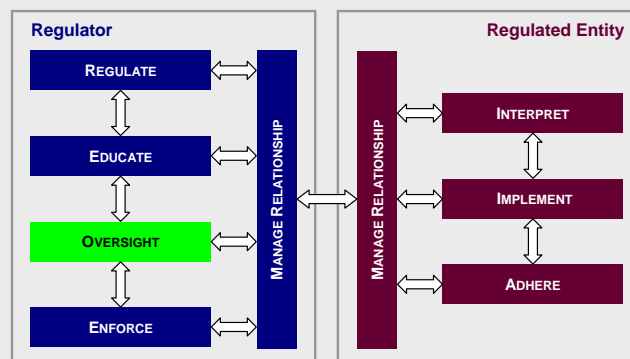
WHY

To drive continuous improvement in safety performance.

How

Establish measures of safety and critically assess performance against safety targets.

Utilisation of safety indicators is a characteristic of the OVERSIGHT function in the regulatory model.





UTILISE SAFETY INDICATORS – IN THEORY

INTRODUCTION

Traditional regulators saw their responsibilities predominantly in terms of auditing and enforcing prescriptive regulations. This approach stems from the provisions of the Convention on International Civil Aviation of 1944 (Chicago Convention). The Convention was based on an assumption that safety can be controlled by anticipating, at a sufficient level of detail, various operational scenarios and prescribing for each of them a normative behaviour developed on the basis of previous experience, lessons learned from accident investigation, and expert knowledge.

To continue the trend of improved safety performance aviation requires a more sophisticated approach. The role of modern-day safety regulatory authorities world-wide is more proactive, involving oversight, which is both surveillance and auditing, not only to check for regulatory compliance but to analyse voluntarily disclosed safety reports and to assess the effectiveness of safety systems rather than just policing in an attempt to compel compliance.

Safety indicators are tactical monitoring and measurement tools to assess safety performance at various levels: the organisational, the aircraft type, or the regulatory system as a whole. Monitoring is done by using basic quantitative data trending tools that generate graphs or charts incorporating alert/target levels commonly used in technical, quality or reliability control systems.

Safety indicators can be used by anyone with access to the data. In this publication we focus on their use by the regulator. Safety indicators allow regulators to assure safety performance by:

- (i) Assessing the performance of organisations against outcome-based regulations.
- (ii) Assessing the performance of organisations against management-based regulation which includes self-defined safety outcomes.^{53,54}
- (iii) Providing intelligence to support prioritisation of inspections, audits and surveys towards those areas of greater safety concern or need, as identified by the analysis of the data on hazards, and their consequences and likelihood in operations.

Finally, regulators should be able to give an account of their performance by:

- (iv) Assessing the performance of the system as a whole by examining regulatory system level performance.

⁵³ Readers unfamiliar with the distinction between outcome-based regulation and management-based regulation should refer to chapter 2.

⁵⁴ For example ICAO (2013) *Safety Management Manual* Doc 9859 3rd edn, SSP Element 3.1 'Safety performance monitoring and measurement' requires organisations to develop safety indicators to determine whether their system is operating in accordance with safety performance expectations in addition to meeting prescriptive regulatory requirements.



DIMENSIONS OF SAFETY INDICATORS

Two dimensions of safety indicators can be distinguished: personal versus process safety, and lead versus lag indicators.⁵⁵ The distinction between personal and process safety is relatively clear. The distinction between lead and lag indicators is somewhat more problematic.

PERSONAL VERSUS PROCESS SAFETY

The first dimension relates to the type of hazard. **Personal safety** hazards give rise to events that primarily affect individual workers. Such events could include slips, trips and electrocutions. Personal safety in workplaces is regulated by work, health and safety legislation.

Process safety hazards give rise to major accidents with the potential to have catastrophic effects and are the result of dangerous materials or uncontrolled changes in energy states. Such events could include explosions, fires and large scale impact. Process safety in aviation is regulated by aviation safety regulators.

The distinction is important for the development of safety indicators. Management of process safety should not rely on personal safety indicators such as injury or fatality data but rather develop its own set of process safety indicators. A focus on personal safety at the expense of process safety was an organisational failing that contributed to the BP Texas City refinery accident in 2005 resulting in the deaths of 15 workers and injuring 180 others. The subsequent investigation found those responsible incorrectly used personal safety metrics to drive safety performance. The investigation concluded that 'personal safety metrics are not a reliable measure of the risk for a major accident'.⁵⁶

LEAD VERSUS LAG

The second dimension is whether the indicator leads or lags the event which you are trying to prevent. An accident, incident or near miss is a sequence of events that unfolds over time. Contributing factors or precursors can be traced back by unfolding the chronology of events as illustrated in Figure 17.⁵⁷ Each point in time is a potential source of a safety indicator.

Lag indicators are measures of performance from data sourced following the occurrence of accidents, incident or near misses. They have a long history of use and are relatively easy to calculate given the data. Lag indicators provide information on past and current performance that may or may not reflect future performance. An example lag indicator is accident rate.

⁵⁵ Hopkins, A (2007) 'Thinking about Process Safety Indicators', Working Paper 53, Regulatory Institutions Network (RegNet), Australian National University.

⁵⁶ US Chemical Safety and Hazard Investigation Board (2007) *Investigation Report: Refinery Explosion and Fire, BP Texas City*, report no 2005-04-I-TX, pp 185.

⁵⁷ Sparrow, M (2008) *The Character of Harms: Operational Challenges in Control*, Cambridge University Press, pp 137.

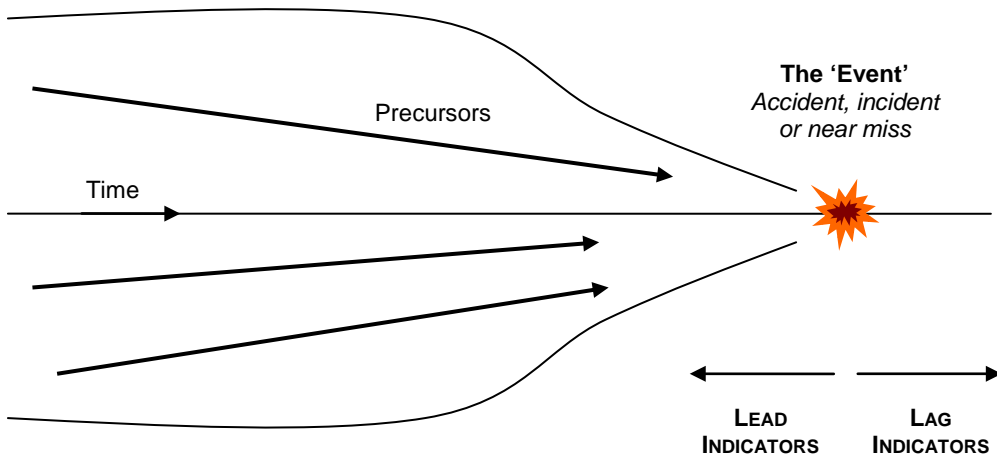


Figure 17. Safety indicators either lead or lag events depending on what and when they are measured.

Lead indicators are measures of performance from data representing potential precursors to future accidents, incidents or near misses. The advantage of lead indicators is that they may potentially indicate negative trends before that which you are trying to affect or ultimately prevent (accident, incident or near miss). They also enable recognition and celebration of success. Lead indicators provide information on past and current performance that is more likely to reflect future performance. An example lead indicator is the level of competence of a workforce – based on the premise that a more competent workforce is less likely to succumb to poor decision making.

DEVELOPMENT OF SAFETY INDICATORS

Functional and process work creates straightforward performance measures about activity or outputs. 'The regulator issued X number of enforcement notices' indicates the regulator may be working hard and keeping busy. 'The regulator made Y number of formal visits and audits' indicates workload volumes. Unfortunately neither of these metrics is particularly indicative of safety performance or of demonstrating effective hazard control. Whether the regulatory tools are effective remains unanswered.

The search for indicators that count can be challenging. The key is to ensure the metrics contribute to answering the question 'show me the hazards you have controlled?' The most important task in developing safety indicators is to enable measurement of the effectiveness of the controls upon which the risk control system relies.



DEFINE HIGHER-VOLUME, PRECURSOR CONDITIONS

The setting of aggregate indicators for catastrophic harms which scarcely happen requires a nuanced approach.⁵⁸ To say the accident rate is zero in a small sample size is unsatisfactory because the nature of catastrophic accidents means there are simply not enough to analyse effectively. Where accidents are occurring frequently enough to be able to talk about a rate, this rate can be used to measure safety. Where accidents are rare, we must look to more frequently occurring precursor events such as major incidents and near misses. From the database of near-misses and major incidents other reportable patterns can be identified and defences regulated or otherwise to manage the hazard, and to monitor their impact on specific problems over time.

When the number of near misses and major incidents have been driven down to a level where there are no longer enough of these to support meaningful analysis then broaden the definition to bring in more data by focussing on minor incidents, gaining the opportunity to ratchet safety up another notch. By viewing it this way there are circumstances in which lag indicators are perfectly good indicators of how well safety is being managed. Furthermore, and referring to Figure 17, depending on the focus of the 'event' (accident, major or minor incident, near miss), a lead indicator may become a lag indicator. The distinction between lead and lag indicators therefore is somewhat irrelevant.⁵⁹ The most important point is that safety indicators must be chosen so as to measure the effectiveness of the controls upon which the risk control system relies.

PROVING CAUSALITY

A perennial problem around any metric or indicator is to prove causality between an intervention and a reduction in safety risk. This issue is fundamental in justifying the value of any hazard-reduction strategy. Whether the safety indicators show an increase or decrease in risk may have little or nothing to do with specific interventions and might be just random.

According to the best available theory the only way to prove causality from a particular course of hazard reduction is to show a continuing trend of reduction in comparison with a similar control sample. This is often not possible. The best and rather insufficient alternative is to describe the specific course of action and qualitatively justify how it links to the improvement in safety performance.⁶⁰

⁵⁸ For a discussion on the challenges of measuring performance see Sparrow, M (2008) *The Character of Harms: Operational Challenges in Control*, Cambridge University Press, pp 123-48.

⁵⁹ Hopkins, A (2007) 'Thinking about Process Safety Indicators', Working Paper 53, Regulatory Institutions Network (RegNet), Australian National University.

⁶⁰ Sparrow, M (2008) *The Character of Harms: Operational Challenges in Control*, Cambridge University Press, pp 130-4.



SOURCES OF SAFETY DATA

To support safety indicators the regulator should establish mechanisms to ensure the capture and storage of data on hazards and safety risks at both an individual and aggregate level. The regulator should have established mechanisms to develop information from the stored data, and to actively exchange safety information with all stakeholders as appropriate.

Sources of data include accident and incident notification systems, hazard and risk management databases, oversight audits, safety management system reporting, contextual data such as aircraft fleet size, age of fleets and the pedigree of certification bases.

Source data can arise from either mandatory or voluntary reporting systems. Mandatory incident reporting systems facilitate the collection of actual or potential safety deficiencies. Voluntary reporting systems facilitate the collection of further actual or potential safety deficiencies that may not be captured by the mandatory reporting system. Voluntary incident reporting systems must be non-punitive and afford protection to the sources of information.⁶¹ Either way the availability of these data sources enables the development of further safety indicators.

A word of warning in regards to the use of voluntary disclosed indicators. A review of the FAAs approach to safety by an independent review team espoused the use of voluntary disclosure programs as a well accepted component of any modern regulatory toolkit. However they cautioned when utilising voluntarily disclosed data for safety performance indication as they are a composite measure, explained as follows.⁶²

The rate at which a regulated entity voluntarily discloses problems is the product of the underlying problem rate they experience multiplied by the rate at which they report those problems. When a low underlying problem rate (all is well) combines with a high reporting rate the indicator is mid range. However exactly the same mid range might be produced if the underlying problem rate were high and the reporting rate low. When such composite measures move up or down one may not be able to tell which is different, the underlying problem rate or the willingness to report. So in the absence of systematic or scientific approaches to unbundling them, it is potentially misleading to interpret variation in such metrics as either good or bad.

⁶¹ Mandatory and voluntary reporting systems are required as part of a State Safety Programme, see ICAO (2013) *Safety Management Manual* Doc 9859 3rd edn, SSP Element 3.2 'Safety data collection, analysis and exchange'.

⁶² Report of the Independent Review Team (2008) *Managing Risks in Civil Aviation – A Review of the FAAs Approach to Safety*, recommendation 6.



UTILISE SAFETY INDICATORS – IN CONTEXT

A BETTER WAY TO REGULATION

The traditional approach of enforcing compliance with prescriptive regulation is no longer sufficient and needs to be supplemented with a more proactive ‘reality check’ process based on safety performance monitoring. To enable the benefit of proactive oversight, analysis of voluntarily disclosed safety reports and assessment of the effectiveness of safety systems **Defence aviation should utilise safety indicators.**

ICAO APPROACH

An approach for developing and implementing safety indicators comes from the ICAO State Safety Programme applicable to civil aviation regulatory authorities. The ICAO SSP approach to safety indicators is considered the most relevant and useful for Defence aviation purposes. The steps involved in developing and implementing safety indicators are as follows:⁶³

- (i) Establish a mandatory or reportable occurrence procedure for certificated/approved service providers of each aviation sector to report accidents and serious incidents on a mandatory basis;
- (ii) Establish requirements for service providers to have an internal occurrence investigation and resolution process that documents the investigation results and makes the reports available to their respective regulatory organisation;
- (iii) Ensure there is an appropriate integration, consolidation and aggregation of data collected from the various aviation providers at the State Safety Programme level. Safety data should not exist as independent or stand-alone databases at the individual provider only. This integration aspect should also be addressed for the respective safety databases of the regulator and the independent accident investigatory authority;
- (iv) Establish basic high consequence safety indicators and their associated target and alert settings. Examples of high consequence safety indicators are accident rates, serious incident rates and monitoring of high-risk, regulatory noncompliance outcomes;
- (v) Establish a State level voluntary reporting system, including information for safety information protection;
- (vi) Establish lower-consequence safety and/or quality indicators with appropriate target and alert monitoring; and

⁶³ ICAO (2013) *Safety Management Manual* Doc 9859 3rd edn, para 4.4.2 and 4.4.16. Here *State* refers to ICAO contracting states – countries who are signatories to the Chicago Convention. For our purposes this can be taken to mean *Defence*. *State Safety Programme* can be taken to mean *Defence Aviation Safety Program*.



- (vii) Promote safety information exchange and sharing amongst the State's regulatory and administrative organisations and service providers, as well as with other States and industry.

The remainder of this chapter provides examples of safety indicators. Methods of collection are beyond the scope of this publication.

EXAMPLES OF INDICATORS

The following is a consolidated list of potential safety indicators.^{64,65} Each may be used for multiple purposes, discussed later in this chapter.

ACCIDENTS

Aircraft accidents are the most obvious lag indicator which, in a development aviation community, should be rare and therefore not a useful indicator on which to base ongoing management decisions.

INCIDENTS

Aircraft incidents provide a better source of information concerning the performance of aviation safety and airworthiness. When trended these lag indicators provide a good indication of system health, particularly when considering an incident as a precursor to an accident if combined with other precursors.

Such incidents may be grouped by hazard types, such as environmental hazards, materiel failures, aircrew errors and maintenance errors. Some examples include:

- (i) Breakdown of separations;
- (ii) TCAS Resolution Advisories;
- (iii) Violations of controlled airspace;
- (iv) Runway incursions;
- (v) Birdstrikes;
- (vi) Mission abort rate;
- (vii) Engine in-flight shutdown rate;

⁶⁴ Smith, N.A. (2007) *ADF Airworthiness Management System Review*, unpublished.

⁶⁵ Australian Transport Safety Bureau (2005) *Aviation Safety Indicators – A Report on Safety Indicators Relating to Australian Aviation*, B2005/0046, Canberra. This publication and its predecessors were published as a response to a recommendation from the 1995 *Plane Safe* report by the House of Representatives Standing Committee on Transport, Communications and Infrastructure.



WORKFORCE

Deficiencies in workforce may lead to an increased likelihood of an unsafe situation. Workforce focused safety indicators are lead indicators. Some examples are described here.

Workforce competence can roughly be measured as the combination of training and experience. With respect to the operational workforce, this is adequately captured by the various categorisations schemes. Generally, maintenance workforce competency is measured as average time in trade, average time on aircraft type and as average time in rank. However, experience levels are often obscured by the use of average experience. A better means is the number of trained personnel with more than two years of competence in their role. For example, an acceptable level of experience (for technicians with two years on type) might be set at 60%. A figure below this level would indicate that the supervision in the unit is stretched and thus would be an area of concern.

Workforce strength/task ratio assumes that the unit has been established to meet authorised tasking rates. The ratio then is simply a ratio of the two percentages: percentages strength (compared to establishment) divided by the percentage tasking. For example, if the unit is manned to 80% of its establishment and is being tasked 110%, then the strength/task ratio is 73% and should be cause for concern. The strength/task ratio needs to be considered in conjunction with the competence measure.

Other workforce stress indicators of a maintenance workforce under stress may include unrecompensed overtime (leave in lieu bill), recreation leave liability per member, rate of carried forward unserviceabilities and cannibalisation rates.

Workforce attitude and culture surveys are essential to fill the data gap that audits cannot capture. An argument exists that the exposure of the results to senior command conflicts with the principles that the confidentiality of members must be preserved to ensure ongoing validity of survey results. This is valid on an individual basis but should not apply to aggregated data sets. This data should be available on a need to know basis, which includes regulatory staff for the purpose of assessing safety performance.

OPERATIONAL ACTIVITY

Hours/sorties flown may be used to prioritise surveillance inspections and also to normalise other data to a rate.

Age of aircraft may be used to prioritise surveillance inspections, relative to other similar aircraft.

Hazard assessments reviewed/updated is not particularly helpful alone but can be normalised and compared against other organisations/aircraft fleets to determine a comparative level.

Safety meetings as for hazard assessments.



LEVEL OF REGULATORY COMPLIANCE

Audit compliance is another possible indicator for assessing the safety performance of an organisation. A crude means is the number of corrective action requests issued through internal and external surveillance audits. This is not a recommended approach as it tends to measure activity of the regulator rather than the actual level of compliance. A better indicator is the time to close out action requests and the quality of the close out information provided.

HOW TO USE SAFETY INDICATORS

Measuring the workforce strength/task ratio at an operating unit tells us nothing about the performance of the Defence aviation regulatory regime. Likewise the aggregate Defence aviation accident rate tells us little about the safety performance of an operating unit. Safety indicators need to be utilised at the right level and for the right purpose. The usefulness of safety indicators are predicated on asking 'what are you trying to determine, and what can the indicator tell you?'

Additionally, indicators which measure how hard the regulator is working are not at all related to safety outcomes. Numbers of corrective action requests, numbers of audits, visits and phone calls are all process measures that are useful for the regulator to understand from a process management point of view, but are not necessarily indicators related to safety.

OPERATING/SUPPORTING UNIT PERFORMANCE

At the operating or supporting unit level, safety indicators are used to quantify the stressors that are applicable to an operating or supporting unit that may lead to an increased likelihood of an unsafe situation by:

- (i) Assessing the performance of organisations against outcome-based regulations;
- (ii) Assessing the performance of organisations against management-based regulation which includes self-defined safety outcomes; and
- (iii) Providing intelligence to support prioritisation of inspections, audits and surveys towards those areas of greater safety concern or need, as identified by the analysis of the data on hazards, and their consequences and likelihood in operations;⁶⁶

⁶⁶ In other words support risk-based oversight, discussed in chapter 8.



Box 12: In-practice – example safety indicator ‘engine-related mission abort rate’

Figure 18 is an example of the engine-related mission abort rate per 1,000 air frame hours for a fictitious aircraft type. As of 2013 this metric was measured by the regulator in order to provide an indication of the safety performance of aircraft fleets, as part of oversight of organisations subject to TAREG 3.5.5 – *Engine Structural Integrity Management*.

Normal, marginal and high levels are calculated using basic statistical methods. As a lag indicator this only presents past performance however it is still of value as marginal and high rates of engine-related mission abort can be further investigated and rectified to prevent further poor performance.

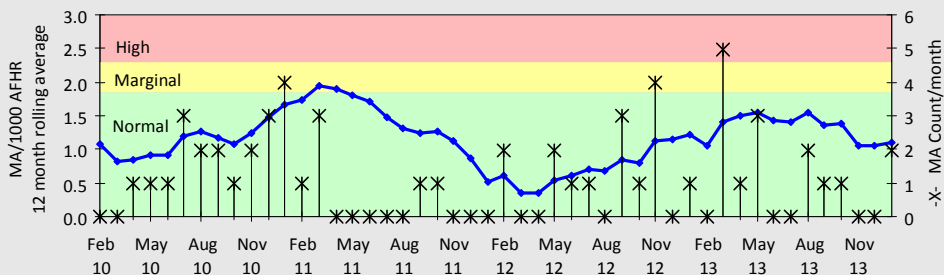


Figure 18. Engine-related mission abort rate. An example lag indicator for an aircraft fleet.

REGULATORY SYSTEM PERFORMANCE

Safety indicators are also used to assess the performance of the aggregate regulatory regime or wider aviation safety program. The Defence Aviation Safety Health Indicators on the following page are such an example.

FURTHER READING

Readers are advised to see the ICAO *Safety Management Manual* for further information on developing safety indicators. The manual provides further information on developing safety indicators for the State Safety Programme level by focussing on aggregated data for assessing systemic performance and for organisations' safety management systems (organisational level). The same principles apply.



Box 13: In-practice – 2014 Defence aviation safety health indicators (DASHI)

DASHI have been reported annually since 2009 in the Defence Aviation Safety Health Assessment (DASHA). The DASHA is intended to provide a consolidated view of key aviation safety issues and trends across the Defence Aviation Safety Program.

DASHI 01. Level of Regulation Compliance. Assesses the level of regulatory compliance against Defence airworthiness regulations.

DASHI 02. Workforce Competency Levels. Assesses the general competency and experience of the aviation workforce to deliver required outcomes. This indicator is assessed against the three key aviation workforce categories of aircrew, maintenance and engineering.

DASHI 03. Workforce Strength to Task Ratio. Assesses whether the strength of the aviation workforce is sufficient to deliver current tasking levels. This indicator is assessed against the three key aviation workforce categories of aircrew, maintenance and engineering.

DASHI 04. Workforce Culture. Assesses whether the current workforce culture is consistent with maintaining a robust and effective airworthiness system, in terms of level of commitment, level of safety culture and degree to which violating behaviour is present.

DASHI 05. Application of Risk Management Practices. Assesses the risk management practices.

DASHI 06. Aviation Safety Occurrences. Assesses whether any fundamental trends exist in the reporting rate of safety occurrences, grouped by accidents, serious incidents, incidents and events.

DASHI 07. OIP and Aeronautical Information. Assesses whether Orders, Instructions and Publications (OIP), including the delivery of Aeronautical Information Services, are being maintained at an appropriate level to ensure the airworthiness of aviation assets.

DASHI 08. Platform Supportability. Assesses the degree to which platform supportability (including the requirement for upgrade programs) is having a negative impact on aircrew competency levels and maintenance workload.

DASHI 09. Aviation Support Environment. Assesses whether there are any deficiencies within the Aviation Support Environment that are having a negative impact on the health of the Airworthiness Management System, or on discrete aviation assets within this system.

DASHI 10. Management of ACARs. Assesses the management of Airworthiness Board Corrective Action Requests (ACARs) in ensuring their timely and effective closure.







8. APPLY RISK-BASED OVERSIGHT

IN SUMMARY

WHAT

Use a robust risk-based assessment process to allocate finite oversight resources most effectively.

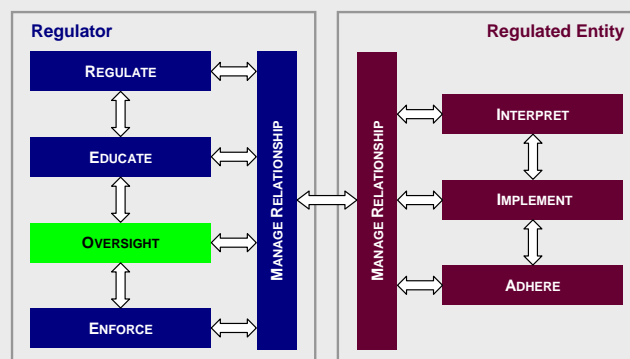
WHY

Improves airworthiness assurance by focussing scarce resources according to risk.

How

Use a robust risk assessment process to allocate oversight resources most effectively.

Utilisation of safety indicators is a characteristic of the OVERSIGHT function in the regulatory model.





APPLY RISK-BASED OVERSIGHT – IN THEORY

The characteristics of an effective state safety oversight system include...employing risk management strategies to assist in the effective use of resources.⁶⁷

INTRODUCTION

Oversight is the function by which regulators assure that each member of the regulated community, and the products or services they produce, is compliant with the regulation. Oversight encompasses both the review that is done when issuing an approval for the first time and the continuous surveillance thereafter.

To undertake oversight a regulator will conduct audits, analyse operations, identify deficiencies, make recommendations, impose operating restrictions, as well as grant, suspend, revoke or terminate certificates or other approvals.⁶⁸ More challenging is the expectation that a regulator is to apply their limited oversight resources across each member of the regulated community, each with differing responsibilities and safety cultures, to ensure optimal performance across the entire sector and do it continuously.

Given the main objectives of the safety oversight function, the generic components of a safety oversight system are:

- (i) Monitoring of safety performance;
- (ii) Verifying compliance with applicable safety regulatory requirements;
- (iii) Safety regulatory auditing;
- (iv) Oversight of new or changed systems, operations, products or procedures;
- (v) Publication of regulatory instructions or advisory material based on findings of oversight activities; and
- (vi) Generation and maintenance of safety oversight records.

This chapter examines how best to apply finite resources to the oversight function.

FACTORS THAT INFLUENCE OVERSIGHT

A range of factors influence how a regulator may choose to undertake its oversight responsibility, including:

- Financial or human resource constraints;

⁶⁷ ICAO (2006) *Safety Oversight Manual* Doc 9734 Part A 2nd edn, para 2.4.7.

⁶⁸ *Ibid*, para 3.8.4.



- Ability to adapt to changing regulatory environments;
- Ability to cater for changes to regulation;
- Ability to cater to the dynamics of regulated organisations;
- Nature of the organisations under oversight, for example, Defence or industry;
- Alignment with other national and military airworthiness authorities;
- Ability to respond to safety incidents and events; and
- Historical approach to oversight.

RISK-BASED OVERSIGHT

A risk-based approach to oversight means differentiating engagement with each member of the regulated community based on an assessment of their relative likelihood of noncompliance and the consequences of any potential noncompliance. This not only enables allocation of oversight resources where they can do the most good – in areas of higher risk and consequence – but also reduces the overall compliance costs by reducing unnecessary inspections or data requirements. To determine compliance risk a relative risk profile is developed for each regulated entity and used to differentiate oversight activities.

Risk-based approach to oversight is the pre-eminent trend in oversight across diverse domains including safety, finance and tax. ICAO use a risk-based approach to auditing of civil regulators through their Universal Safety Oversight Audit Program – Continuous Monitoring Approach (USOAP CMA) and recommend civil regulators adopt a risk-based approach in their own oversight function.^{69,70}

The risk associated with noncompliance of regulations by members of the regulated community can be assessed by examining a range of factors, including the nature of the organisation and the environment in which it operates. The consequence of noncompliance may be assessed against the nature of the aviation materiel that the organisation is responsible for, its intended use and an understanding of impact if the aviation materiel failed due to a latent design, construction and maintenance or supply-chain error. The overall outcome of this risk-based approach determines the level of oversight that the organisation shall be subject to.

⁶⁹ ICAO (2011) *Universal Safety Oversight Audit Programme Continuous Monitoring Manual* Doc 9735 3rd edn, chap 3 'The Continuous Monitoring Approach'.

⁷⁰ ICAO (2013) *Safety Management Manual* Doc 9859 3rd edn, SSP Element 3.3 'Safety-data-driven targeting of oversight of areas of greater concern or need', para 4.2.36.



THE RISK-BASED APPROACH

Risk profiles are based on various safety risk indicators that identify or highlight specific information related to that organisation that needs to be considered in identifying and prioritising the regulator's oversight activities. The USOAP CMA process consists of the following four components:

- (i) Collection of safety information;
- (ii) Determination of safety risk profile;
- (iii) Prioritisation of oversight activities; and
- (iv) Updating summary safety capability metrics for each regulated entity.

The risk profile of each regulated entity should be reviewed regularly. In the event of deterioration in a risk profile, the regulator should:

- (i) Increase monitoring;
- (ii) Provide or facilitate assistance;
- (iii) Consider financial or technical aid; and/or
- (iv) Reassess or more closely monitor existing technical assistance projects.

DETERMINATION OF RISK PROFILE

Data used to develop risk profiles may include safety performance indicators related to the specific regulated entity or relevant wider metrics, results from previous surveillance activities or audits of the particular entity. More comprehensive intelligence could include safety risk data external to the regulator itself, such as organisational safety culture surveys.



APPLY RISK-BASED OVERSIGHT – IN CONTEXT

With the introduction of safety management systems, the oversight function has assumed even greater importance.⁷¹

A BETTER WAY TO REGULATION

The traditional approach of conducting oversight on a fixed-schedule is burdensome and resource intensive. **Defence aviation safety regulators should apply a risk-based safety oversight approach to identify and prioritise oversight activities.** This not only enables allocation of resources where they can do the most good – in areas of higher risk and consequence – but also reduces the overall compliance costs by reducing unnecessary inspections or data requirements.

A PRACTICAL DEFENCE AVIATION APPROACH

The Defence aviation regulators would usually not reduce the level of oversight during initial compliance assessments, when issuing instruments of organisational or key personnel approvals. However the risk-based approach and the benefits it entails is enacted following initial assessment. After initial assessment, the level of oversight can be reduced or increased as required.

The risk-based approach to oversight requires a subjective assessment of an organisation's risk of regulatory noncompliance, over a set period such as twelve months. The assessed risk of noncompliance is then normalised relative to the other organisations. This approach ensures that the limited oversight resources are applied for the best effect for the entire Defence system.

One of the benefits of the aviation regulator existing within Defence is that it is able to use risk based oversight processes more easily because it is more familiar with the owner, the operators and their risks.

COLLECTION OF SAFETY INFORMATION

Safety information could consist of any of the example safety indicators discussed in chapter 7. Suffice to say good quality risk-based oversight is challenging without access to an adequate array of safety indicators.

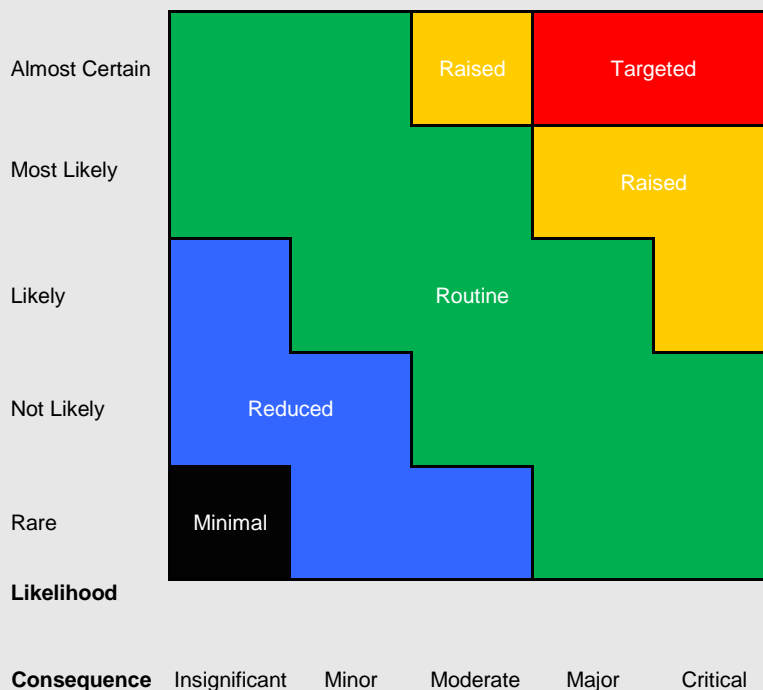
DETERMINATION OF RISK PROFILE

A simple tool to support risk-based oversight is assigning a risk-hazard index (RHI) based on established criteria. Organisations are mapped on the RHI and allocated a surveillance level based on the band in which they fall.

⁷¹ ICAO (2006) *Safety Oversight Manual* Doc 9734 Part A, 2nd edn, para 3.8.8.



Box 14: In-practice – an example risk-hazard index for determining risk profiles



CONSEQUENCE OF ORGANISATIONAL NONCOMPLIANCE WITH REGULATION

The underlying purpose of the horizontal axis of an RHI is to differentiate organisations based on the consequences of regulatory noncompliance, with a clear understanding that ‘noncompliance’ means that the defences may not be sufficiently strong to protect the aviation materiel from latent error. Latent design and maintenance errors are a problem because they might not be discovered before the equipment is operated, and a loss of function during operation could jeopardise safety, capability or efficiencies.

As such the following factors can be used to collectively help distribute organisations based on the consequences of organisational noncompliance with the regulations:

- (i) Whether the aviation materiel is classified as whole aircraft/engine, or whether the aviation materiel is classified as equipment-only with a functional/physical interface to the aircraft.
- (ii) The extent to which an organisation conducts maintenance or design on whole of aircraft/engines, or maintenance or design on safety critical systems.



- (iii) The extent to which a potential latent error in maintenance or design could be discovered, or not, by a different organisation that is further along the chain before the equipment is used by an operator.
- (iv) The total number of people placed at risk of injury should the aircraft/engine/equipment lose a safety critical function due to latent error.
- (v) The potential impact on safety, capability or efficiencies should aviation equipment - with a functional/physical interface to the aircraft/engine - lose its most critical function due to a latent error.

Many of these factors are interrelated, while others are mutually exclusive. This complex relationship can make it difficult to assess organisations in a standardised manner. A better understanding may be achieved by incorporating the PBP bow tie described in chapter 1.

LIKELIHOOD OF ORGANISATIONAL NONCOMPLIANCE WITH REGULATION

The underlying purpose of the vertical axis on the RHI is to differentiate organisations based on the likelihood of organisational noncompliance with the regulations in the near term. An organisation's likelihood assessment is expected to be somewhat volatile, while the consequence assessment is expected to be somewhat fixed. This means the organisations will move vertically within an RHI column as the organisation experiences internal changes, or suffers pressures from the environment within which it operates.

While past compliance history will be a factor in determining a likelihood level, past compliance history will not be the prime driver. Rather the likelihood ratings are to be predictive in nature and regulatory staff are still expected to exercise professional judgement in assigning a likelihood rating.

LIMITATIONS IN USING RISK HAZARD INDEX

RHIs are usually developed for a very specific context and used internally by the owning organisation to provide a simple and reasonably reliable means of assessing risk. However, when a RHI is used out of context the results can become nonsensical, which often occurs when external organisations and stakeholders use the relative and subjective results of a RHI as an absolute measure of risk, performance or health. These limitations need to be understood and clearly explained when surveillance level descriptors are communicated to organisations and stakeholders.

Furthermore, surveillance level descriptors are not measures of organisational performance or health themselves. The extent to which an organisation complies with regulations is but one contributor in assuring safety performance. Hence RHI cannot and should not be used to infer a measure of organisational health because the RHI neither assesses workforce attitudes nor assesses the culture of an organisation in determining the surveillance level. Organisations may operate in a fully compliant manner and yet continue to have incidents in which individual people demonstrate unsafe behaviours, indicative of inappropriate workforce attitudes and/or poor



organisational cultures. A compliant culture is one example, where an organisation focuses entirely on regulatory compliance at the expense of measuring safety performance.







9. TAKE A GRADUATED RESPONSE

IN SUMMARY

WHAT

Escalate enforcement remedies to elicit acceptable and compliant behaviour proportional to the observed behaviour and intent of the regulated entity.

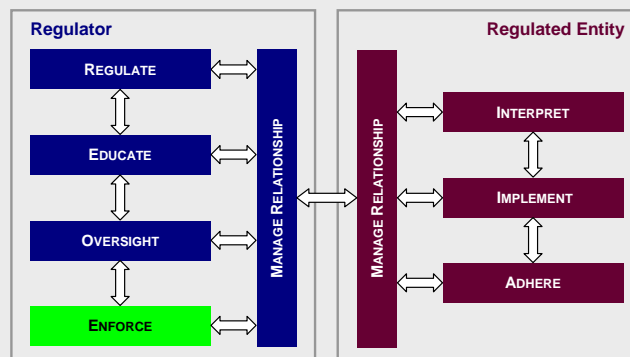
WHY

Incentivise strong safety culture rather than penalising minor infractions.

How

Escalate remedies to elicit acceptable and compliant behaviour proportional to the observed behaviour and intent of the regulated entity.

Graduated response is a characteristic of the ENFORCE function in the regulatory model.





TAKE A GRADUATED RESPONSE – IN THEORY

INTRODUCTION

Regulatory enforcement is the function undertaken by the regulator to ensure compliance when noncompliance is observed.

Noncompliance may be for a variety of reasons: the regulated entity may not know about their regulatory obligations, may not agree with them, may not be capable of complying with them, may find them too costly to comply, or simply may not care. The challenge for regulators is to develop enforcement approaches which address all these obstacles. Much innovative work has been undertaken in Australia on this topic. Some theory is presented here to introduce the graduated response to enforcement.⁷²

PERSPECTIVES ON COMPLIANCE MOTIVATORS

Regulatory theorists explain the motivators behind regulatory compliance in various ways. According to classical deterrence theory compliance is one dimensional: individuals are self interested and comply if it is in their best interest by balancing the risks of detection of non compliance. A more modern theory has two elements.⁷³

- (i) *Negative* motivations arise from fears of the consequences of being found in violation of regulatory requirements; or
- (ii) *Affirmative* motivations arise out of good intentions and a sense of obligation to comply.

The line between the two is not always clear because they interact in influencing compliance. Nonetheless, the distinction is useful in helping to think about better regulatory outcomes.

The basic logic of enforced sanctions or punitive measures of enforcement is that of a criminal law model of deterrence. From this perspective, individuals and organisations comply because they fear the consequences of being found in violation of the regulatory requirements.

The second perspective is that of an unwritten social contract involving expectations and obligations on the part of both regulators and regulated. Regulators approve – either explicitly with licenses or certificates, or implicitly by not issuing sanctions – actions to address harms taken by members of the regulated community, while in exchange members offer compliance with regulations and gain social benefit associated with that compliance. This contract is more likely to develop over repeated actions together and with a shared common goal. Inherent in this perspective is a more positive assessment of the willingness of the regulated community to comply, to ‘do the right thing’.

⁷² Graduated response described here is referred to in academic literature as *responsive regulation*.

⁷³ May, P.J. (2004) ‘Compliance Motivations: Affirmative and Negative Bases’, *Law & Society Review*, vol 38 no 1.



The notion of the social contract is tempered somewhat by the understanding that social norms act less upon complex organisations than individuals. The study of organisational deviance tells us that one should think of personnel as actors who assume certain roles as defined by the organisation, not by their personality. This explains how an organisation can act in a way that is prejudicial to safety in ways that most personnel within the organisation individually would not condone.

EFFECT OF ENFORCEMENT STYLE ON COMPLIANCE MOTIVATORS

The approach by regulatory staff to interaction with the regulated community constitutes enforcement style. Enforcement style also affects compliance motivators, so it is useful to understand the different styles and how they will affect compliance.

Case studies have shown enforcement styles can vary along two dimensions:⁷⁴

- (i) The degree to which enforcement style is **facilitative** – from helpful and friendly, to unhelpful and threatening; and
- (ii) The degree to which enforcement style is **formal** – from flexible and less picky, to rigid and picky.

While different combinations of these styles are possible, of interest here is how more or less of each influences motivations to comply. Increased facilitation fosters affirmative motivations while detracting from negative motivations. This is intuitive, because facilitation, by definition, leads to a greater understanding of the basis of regulations and means for complying with them.

Increased formalism contributes to negative motivations while detracting from affirmative motivations. Formalism adds little to the understanding of the basis for rules and as such does not enhance affirmative motivations. Formalism undermines affirmative motivations if the regulatory staff member is indifferent, threatening or similar, because it undermines confidence in the system.

Formality and minimal facilitation is an appropriate enforcement approach in some circumstances. Informality and high facilitation is also an appropriate approach in some circumstances. Naturally, combinations exist in between these two extremes.

GRADUATED RESPONSE

Armed with a better understanding of the motivations of the regulated community it becomes clearer as to why punitive enforcement action in *all* cases of noncompliance makes the job of the regulator more difficult. The regulator needs a better enforcement approach that avoids using persuasion on those with no will to comply and using punishment on those trying to do their best. Such an approach exists and is called the **graduated response** to enforcement.

⁷⁴ May, P.J. (2004) 'Compliance Motivations: Affirmative and Negative Bases', *Law & Society Review*, vol 38 no 1.



The basic principle of the graduated response approach to enforcement is for the regulator to respond to the culture, conduct and context of those they seek to regulate when deciding whether a more or less interventionist response is needed, rather than default to punitive measures.⁷⁵

The theory of responsive regulation, upon which the graduated response method is based, has been an influential policy idea and utilised across many Australian jurisdictions including the Australian Taxation Office, Australian Securities and Investment Commission and Office of Transport Security (OTS).

The 1992 book *Responsive Regulation* by Ian Ayres and John Braithwaite was influential in defining an ‘enforcement pyramid’, up which regulators would progress depending on the seriousness of the regulatory risk, and the noncompliance of the regulated business. An example is in Figure 19. The theory is that regulatory compliance is best secured by persuasion in the first instance, with inspection, enforcement notices and penalties being used for more ‘risky’ businesses further up the pyramid.

Responsive regulation strikes a balance between, and helps to answer the question, when to punish and when to persuade. Its popularity has come about because not only is it simple but it reconciles better than any other theory the clear empirical evidence that sometimes punishment works and sometimes it backfires – and likewise with persuasion.

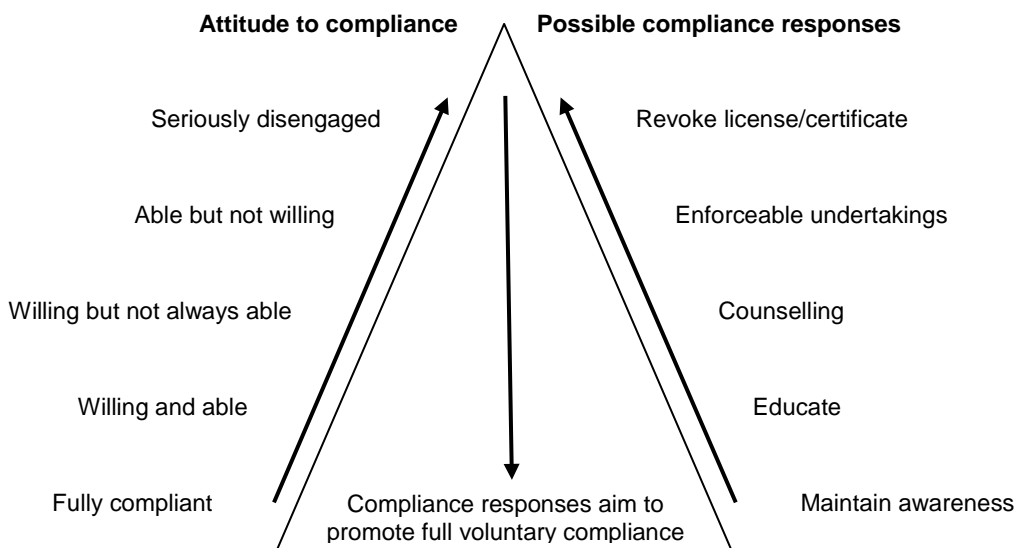


Figure 19. An example enforcement pyramid.

⁷⁵ Wood, C et al (2010) ‘Applications of Responsive Regulatory Theory in Australia and Overseas’, Occasional Paper 15, Regulatory Institutions Network (RegNet), Australian National University.



The theory states that compliance is more likely when a regulator displays an explicit enforcement approach and sticks to it. The left side of the pyramid represents the regulated entity's attitude to compliance. At the base is fully willing and able, in the middle is willing but not always able and at the top is unwilling and recalcitrant.

The right side represents the regulators' response. At the base are advisory and persuasive measures, the middle mild administrative sanctions and at the top are more punitive sanctions, determined to be sufficiently undesirable to halt the behaviour of the most determined offenders.

There are three critical elements to its implementation. Firstly, a full explanation of the process to the regulated community – so they know what to expect. Secondly, inherent respect for each member of the regulated community by always executing enforcement procedures from the bottom of the triangle. Thirdly, an escalation of response in the absence of a genuine effort by a member of the regulated community to meet the required standard. The speed of escalation should depend on an assessment of the organisation's motivational stance, prior interaction, and capacity to meet the regulations.⁷⁶

- (i) Entities found noncompliant who were willing and made a genuine effort should receive education and counselling;
- (ii) Entities not willing or who lack genuine effort should be met with deterrence tools if unwilling to change their attitude rapidly; and
- (iii) Incompetent and/or irrational actors should be incapacitated with limited notice.

Escalation and de-escalation is possible throughout the course of the relationship between the regulator and regulated, and indeed possible within the same 'encounter'.

⁷⁶ Baldwin, R. & Black, J. (2007) 'Really Responsive Regulation', *LSE Law, Society and Economy Working Papers* 15/2007, London School of Economics and Political Science.



TAKE A GRADUATED RESPONSE – IN CONTEXT

The Panel recommends that...the Civil Aviation Safety Authority reintroduces a ‘use of discretion’ procedure that gives operators or individuals the opportunity to discuss and, if necessary, remedy a perceived breach prior to CASA taking formal action.⁷⁷

A BETTER WAY TO REGULATION

The traditional enforcement strategy is to apply punitive measures to any noncompliant member of the regulated community and to threaten anyone who is compliant to remain compliant. A better way is to take an enforcement approach that recognises and takes account of compliance motivators. In order to improve the level of compliance and enable the benefit of proactive oversight **Defence aviation safety regulators should take a graduated response to regulatory enforcement.**

ENFORCEMENT ACTION IN CIVIL AVIATION

ICAO takes a relatively simple approach to expressing a graduated response to regulatory enforcement (without using such terminology) by promoting the following principles to State regulatory authorities:⁷⁸

- (i) The State’s regulatory authority will take action against those who consistently and deliberately operate outside civil aviation regulations;
- (ii) The State’s regulatory authority will seek to educate and promote training or supervision of those who show commitment to resolving safety deficiencies; and
- (iii) The State’s regulatory authority will give due and equitable consideration to distinguish premeditated violations from unintentional errors or deviations.

In Australia CASA implement these principles and bring about compliance in four ways:⁷⁹

- (i) Assisting the regulated community to comply, generally and on an individual basis through educational activities, advice and safety promotion.
- (ii) Encouraging or exhorting compliance through counselling, remedial training or infringement notices.
- (iii) Compelling compliance through the suspension or cancelling of authorisations, the variation of authorisations which may include imposition of conditions, and by enforcing voluntary undertakings.

⁷⁷ Australian Government (2014) *Aviation Safety Regulation Review*, Canberra, recommendation 18. The review was commissioned by the Australian Government to improve the civil aviation regulatory system.

⁷⁸ ICAO (2013) *Safety Management Manual* Doc 9859 3rd edn, appx 10 to chap 4.

⁷⁹ Civil Aviation Safety Authority (2013) *CASA Enforcement Manual*, v 4.3, chap 2, pp 4.



- (iv) Initiate penalty action (by recommendation to the Commonwealth Director of Public Prosecution) including fines and custodial sentences.⁸⁰

CASA only refers to the latter two as enforcement actions. The first two are referred to as compliance actions. When deciding whether to take enforcement actions CASA considers the nature of the noncompliance including whether it was intentional, nature of the evidence, the kind of action required to address the noncompliance, the obligation to be fair and consistent, and any policy of the Commonwealth Director of Public Prosecutions.⁸¹

ENFORCEMENT ACTION IN DEFENCE AVIATION

The enforcement approach should involve the development of a Defence aviation safety regulation enforcement triangle tailored to account for the motivations of the regulated community. Furthermore, it should provide advice to regulatory staff as to the appropriate use of formality/informality and facilitative/threatening approaches as follows:

- (i) A compliant position due to affirmative motivations should be reinforced with a facilitative and informal enforcement approach;
- (ii) A compliant position due to negative motivations should be reinforced with a formal and punitive approach;
- (iii) A noncompliant position with an affirmative approach should be corrected with a facilitative and informal enforcement approach;
- (iv) A noncompliant position with a negative motivation should be corrected with a formal and more threatening approach; and
- (v) A noncompliant position due to intentional disregard should be corrected with the most formal and most threatening approach.

⁸⁰ Only a court (not CASA or the Commonwealth Director of Prosecutions) has the authority to impose a penalty for a breach of the Civil Aviation Act or Civil Aviation Safety Regulations.

⁸¹ Civil Aviation Safety Authority (2013) *CASA Enforcement Manual*, v 4.3, chap 3, pp 15.



Box 15: In-practice – an example aviation safety regulation enforcement triangle

Figure 20 is an example of a possible enforcement triangle which could form the basis of an enforcement policy.

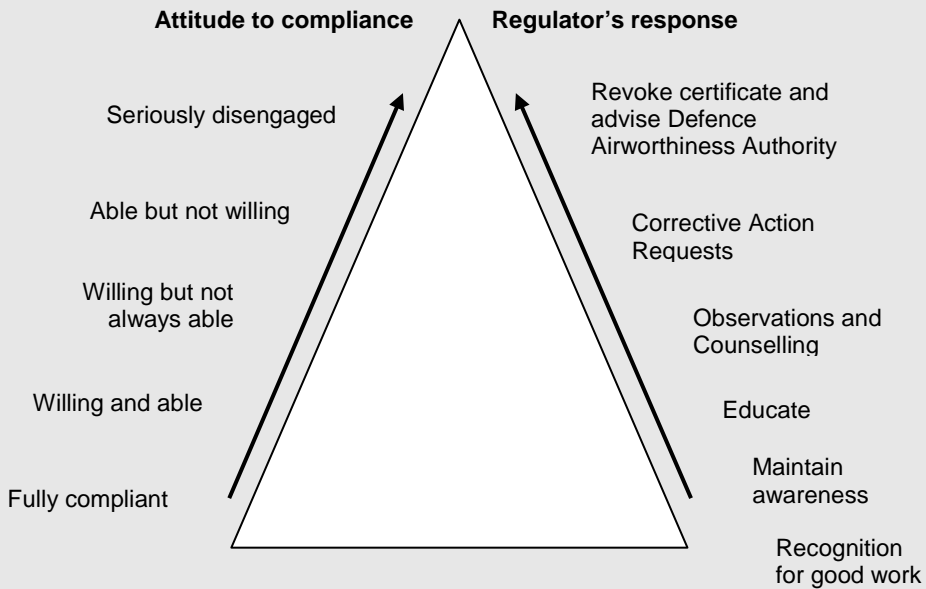


Figure 20. An example aviation safety regulation enforcement triangle.







10. ESTABLISH GENUINE ENGAGEMENT

IN SUMMARY

WHAT

Aim to develop mutual respect, appreciating the natural tension between regulators and the regulated community.

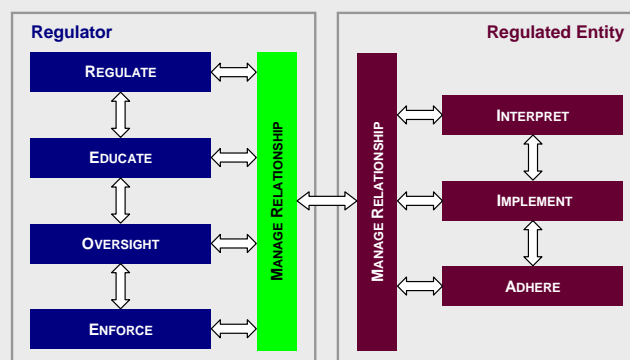
WHY

Regulatory outcomes will be enhanced if mutual respect exists between regulators and the regulated community.

How

Engage with the regulated community using formal and informal approaches. Appreciate the natural tension between regulators and the regulated community.

Genuine engagement is a characteristic of the MANAGE RELATIONSHIP function in the regulatory model.





ESTABLISH GENUINE ENGAGEMENT – IN THEORY

Regulators, by their conduct in interpreting, administering and enforcing regulatory requirements, can take considered, well designed regulation and produce regimes which discourage compliance, squander government resources or add to business costs and delays.⁸²

INTRODUCTION

Genuine engagement theory is almost a contradiction in terms. Engagement is after all practical. But it is critical. According to the Productivity Commission regulator behaviour can potentially have as large an effect on compliance costs as the regulations themselves.⁸³ The intent of this chapter is to provide a clear guide to regulatory staff for better engagement between the regulator and the regulated community.

AIM OF GENUINE ENGAGEMENT

In a regulatory environment the relationship between parties ought to be one of mutual respect. Such is the aim of genuine engagement. No worse, no better. Tensions that arise from time to time between parties are expected and not necessarily a bad thing. But punitive regulatory responses at all times is most definitely destructive. The result of a 'heavy handed' approach has been seen in Australian civil aviation where many in industry have been critical of, and reportedly now actively avoid, the safety regulator unless necessary.⁸⁴

BENEFITS OF MUTUAL RESPECT

Interacting genuinely with the intent of establishing mutual respect between the regulator and the regulated community opens advantages that would otherwise be inaccessible.⁸⁵

Regulated Community. Members of the regulated community are more likely to want to take an interest in, rather than avoid the regulator's operations and thereby better understand their compliance expectations.

Regulator. Trust fosters voluntary compliance. Respect will also see improvement in the understanding of the motivation and abilities of the regulated community to meet compliance obligations and thus informs the graduated response approach to enforcement (discussed in

⁸² Australian National Audit Office (2007), *Administering Regulation: Better Practice Guide*, Canberra.

⁸³ Productivity Commission (2013) *Regulator Engagement with Small Business*, Research Report, Canberra.

⁸⁴ Australian Government (2014) *Aviation Safety Regulation Review*, Canberra, s. 4.66 'The use of discretion'. The review was commissioned by the Australian Government to improve the civil aviation regulatory system.

⁸⁵ Productivity Commission (2013) *Regulator Engagement with Small Business*, Research Report, Canberra.



chapter 9). Furthermore it helps to identify compliance challenges and support proactive strategies to address them.

RISKS OF MUTUAL RESPECT

A closer relationship does not come without risk. A regulator that does not appropriately manage its close relationships is in danger of *capture*, which ultimately can compromise the integrity of the regulatory regime. Capture is when a regulator draws so close to those whom it regulates that the agency ends up elevating others' concerns at the expense of their own core mission.

Once captured there is no quick fix. With the integrity of the regime destroyed, incentive for compliance reduces. The result is a step backwards into a punitive compliance culture that, as we have seen elsewhere in this publication, is not the best way to manage the myriad of potential hazards exposed to aviation.

REGULATORS ARE NOT CUSTOMER FOCUSED

Enforcing regulatory requirements while adhering to customer service principles can be a difficult balance to achieve. So customer focussed strategies typical of the private sector are not as helpful for regulators as it may seem. All regulators have to deal with the fundamental reality that being a regulator involves different relationship characteristics, including:⁸⁶

1. A regulator's job is to deliver obligations, not products or services. Trying to emulate the private sector's treatment of customers will not lead to improved regulatory outcomes.
2. In most cases the person dealt with by the regulator is not usually paying for the service, has no choice as to whether or not to accept the service, and is often not the one that benefits from the service. The person or their organisation is obliged to absorb a loss for the benefit of a greater good. So there is generally no reason to expect that the person dealt with will be 'pleased'.
3. Regulators need a more nuanced vocabulary than business to describe the parties to regulatory action. Using the term 'customer' is confusing, misleading and potentially dangerous. Instead regulators use a broader set of terms to describe the various parties they deal with. Common terms include stakeholders, regulated community, regulated entities and industry.
4. Regulators are obliged to treat all parties with respect and dignity. This notion should not in any way conflict with an uncompromising focus on regulatory objectives.

⁸⁶ Sparrow, M (2000) *The Regulatory Craft: Controlling Risks, Solving Problems, and Managing Compliance*, Brookings Institution Press, chap 4 'Customer service: merits and limits'.



TECHNIQUES FOR MANAGING RELATIONSHIP

Genuine engagement is an approach. Establishing mutual respect is the desired outcome. How does the regulator achieve this soft target? According to the Australian National Audit Office the answer lies in clarity and openness which are enhanced when:⁸⁷

- Relationship goals are defined and agreed;
- All parties understand their roles, commitment and obligations;
- Modes of interaction are available that facilitate two-way communication; and
- Procedures for handling disagreements are in place.

DEFINE RELATIONSHIP GOALS

Defining relationship goals means having an understanding between regulators and regulated as to the relationship's purpose. Once defined it is then possible to develop mechanisms and processes of interaction. For example a collaborative relationship looks very different to one of inform.

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
GOAL	Regulator provides industry with balanced, objective, accurate and consistent information regarding rulemaking.	Regulator obtains feedback from industry on analysis, alternatives and/or outcomes.	Regulator and industry work directly throughout the rulemaking process to ensure concerns and needs are understood and considered.	Regulator and industry create partnership to develop alternatives, make decisions and identify preferred solutions.	Regulator places rulemaking decision-making power in the hands of industry.
REGULATOR'S ACTIONS	Regulator keeps industry informed.	Regulator keeps industry informed, listens to and acknowledges concerns, provides feedback on how industry input influences outcome.	Regulator works with industry to ensure concerns are reflected in the alternatives developed and provides feedback on how input influences outcome.	Regulator looks to industry for advice in formulating solutions; incorporates advice into the outcome to the maximum extent possible.	Regulator implements what industry decides.

Figure 21. Relationship goals and corresponding actions of the regulator.

⁸⁷ Australian National Audit Office (2007) *Administering Regulation: Better Practice Guide*, Canberra, chap 4 'Relationship management'.



Referring to Figure 21 above to collaborate and empower involve a significant risk of regulatory capture. Such an approach may be appropriate however for discrete tasks such as where the regulator is unable to resource or influence a lower priority task and it is in the interest of safety assurance for the regulated community to develop a solution on its own.

ARTICULATING ROLES, OBLIGATIONS AND COMMITMENTS

Articulating the roles, obligations and commitments of the regulator and the regulated community defines the terms and conditions for the relationship. For example a 'client service charter' is a tool that enables a regulator to define the parameters of an interactive relationship.

Another tool is a regulatory code of conduct, developed in consultation with stakeholders. A regulatory code of conduct outlines the regulator's priorities and enables the regulated community to formulate their own expectations about how the regulator will administer regulation. Details could include:

- Consultation processes for developing regulations;
- Provision of information on regulations and compliance requirements;
- Approaches to enforcement and penalties, including where breaches are voluntarily notified;
- Processes for dealing with complaints; and
- Timeframes for responses.

Such a code could also define the responsibilities of members of the regulated community.

CONSULTATION PROCESS FOR DEVELOPING REGULATION

The following principles should be considered when developing consultation processes:⁸⁸

Continuous. Relationships with stakeholders already exist. If seeking out people to discuss the policy proposal when developing consultation documentation then the point is missed. Build consultative relationships whenever the opportunity presents itself, not merely when needed.

Broad-based. Consultation should capture the diversity of stakeholders affected by the proposed changes. Use intermediaries where efficient. For example smaller organisations are more likely than larger organisations to rely on third parties to receive information on regulatory requirements, including industry and professional associations. Similarly, junior staff within an organisation are more likely to receive regulatory information from their senior managers rather than directly from the regulator. Ensure the approach is suitably tailored to suit the diversity.

⁸⁸ Australian Government (2014) *Australian Government Guide to Regulation*, Canberra. These seven consultation principles are articulated in 'Regulatory impact statement question 5 – who will you consult and how will you consult them?'



Accessible. Channels for consultation should be relevant to the groups with whom you are consulting. Consider strategies to assist stakeholders who might be significantly impacted by the regulation but do not have the resources and/or ability to prepare a response.

Not burdensome. Many people you wish to consult with have full time jobs so don't make unreasonable demands on them or assume they have unlimited amounts of time to devote to the consultation process. Too much written material may result in information overload and lack of clarity on priorities.

Transparent. The regulator should explain the objectives of the consultation process and when and how the final decision will be made.

Consistent and Flexible. Consistent consultation processes demonstrate you are an experienced and professional regulator. But don't be a slave to the process if there is a simpler way to consult in the circumstances.

Evaluation and Review. Regulators should evaluate consultation processes and continue to examine ways of making them more effective.

Not Rushed. When detailed information is provided as a part of consultation, people need time to understand it, consider it and respond. Give as much time as is reasonable. This could be as much as 60 days and should not be less than 30 days. Rushing the process is likely to lose trust and respect of stakeholders.

A Means Rather than an End. Consultation should be used to improve decisions, not as a substitute for making decisions.

Furthermore, the **Regulatory Impact Statement (RIS)** is a widely used tool that should be incorporated into the regulation development process. The RIS is designed to encourage rigour, innovation and better policy outcomes from the beginning. In summary the RIS seeks policy and regulatory developers across to government to ask seven questions:⁸⁹

- (i) What is the problem you are trying to solve?
- (ii) Why is government action needed?
- (iii) What policy options are you considering?
- (iv) What is the likely net benefit of each option?
- (v) Who will you consult about these options and how will you consult them?
- (vi) What is the best option from those you have considered?
- (vii) How will you implement and evaluate your chosen option?

⁸⁹ Australian Government (2014) *Australian Government Guide to Regulation*, Canberra, pp 5.



FACILITATING TWO-WAY COMMUNICATION

Communication mechanisms established by a regulator are influenced by the:

- Outcomes sought from the relationship;
- Characteristics and motivations of key stakeholders;
- Cost of establishing, maintaining and operating the interface for the regulator; and
- Capacity of the regulated community to use a wide-range of mechanisms.

Effective communication methods include electronic interfaces, single points of contact, formal consultative arrangements, conferences and informal ad-hoc forums.

PROCEDURES FOR HANDLING DISAGREEMENTS

Even though all the above may be in place, disputes will still arise. As a consequence the regulator should develop a well-defined dispute handling process to manage these circumstances. For guidelines to develop a dispute handling process see the ANAOs *Administering Regulation: Better Practice Guide*.⁹⁰

UNDERSTANDING COSTS OF REGULATION

A professional regulator must aim to understand the cost of its regulation on the regulated community. The cost of regulation is the sum of the resources given up by an organisation to achieve regulatory compliance. This includes responding to perceived regulatory requirements which may not be expressly intended by the regulator. It does not include costs that would be expended regardless of the regulation.

There are multiple units of cost measurement. The most common are financial or time based but others less tangible include loss of goodwill and impact on staff morale.

Cost of regulations is primarily borne by the regulated community and, to a lesser extent, the regulator itself. There are three broad categories of costs applicable to the regulated community described as follows and illustrated in Figure 22.

Administrative Compliance is the cost of demonstrating compliance which does not directly contribute to achieving regulatory outcomes. Time spent interacting with the regulator to prove compliance (such as hosting an audit), cost associated with completing forms for the regulator and, importantly, learning about the regulations are all examples.

Substantive Compliance cost is associated with achieving regulatory outcomes. Recruiting an additional maintenance member solely to meet a supervision requirement is an example of a

⁹⁰ Australian National Audit Office (2007) *Administering Regulation: Better Practice Guide*, Canberra, chap 4 'Relationship management'.



substantive cost because it satisfies a regulatory obligation and would not have occurred had the regulation not existed. Costs associated with preparing documentation to satisfy regulatory requirements may be either administrative or substantive depending on their intended use.

Inefficiency/Indirect cost is realised as an indirect consequence of achieving regulatory compliance. In other words second order effects. These are the least understood costs as they are not paid for 'directly'. For example, suppose a regulation requires a particular person to sign off on release of an aircraft and that person was unavailable for a period of time (and no delegation was possible), the cost of waiting (through reduced capability) is an inefficiency cost.

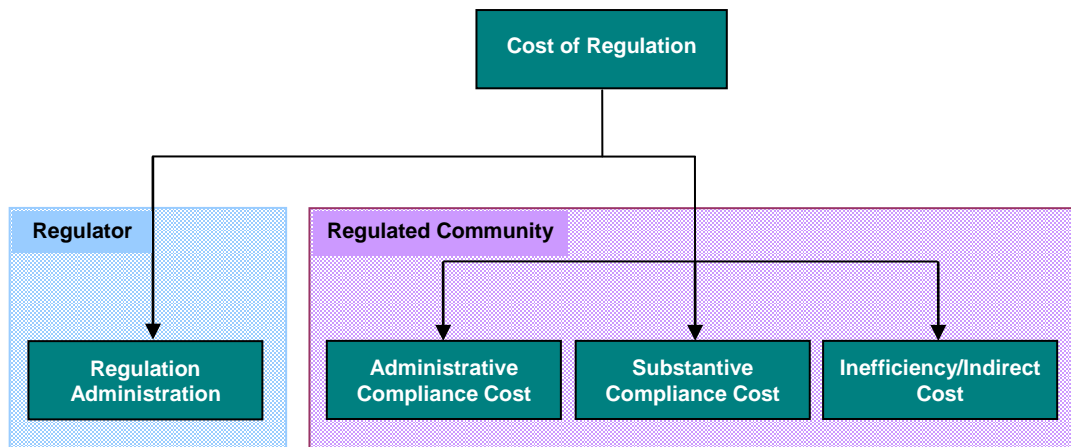


Figure 22. The constituent costs of regulation.

MINIMISING COST OF REGULATION

A regulatory regime is the most cost effective when:

- (i) Administrative compliance costs are kept to the bare minimum, just enough to provide the regulator with enough evidence for them to undertake their oversight role.
- (ii) Substantive compliance costs are zero because the regulated entity meets all the regulatory requirements as a part of normal business and would do so even if the regulations did not exist.
- (iii) Enough flexibility exists within the regulations to ensure inefficiency costs are zero.

Costing of existing regulatory regimes is near impossible other than broad estimates. The best a regulator can do is to cost changes to regulation. This is core to the Regulatory Impact Statement tool. Detailed costing of regulation remains challenging and is beyond the scope of this publication. Cost/benefit analysis and cost effectiveness analysis tools exist to assist with such tasks.



ESTABLISH GENUINE ENGAGEMENT – IN CONTEXT

*The Civil Aviation Authority was never captured by the aviation industry.
On the contrary, the regulator offered itself as a willing captive.*⁹¹

A BETTER WAY TO REGULATION

Attitudes among regulatory staff as to the best style and methods of interacting with the regulatory community will vary widely. Some will believe in the importance of tough enforcement and see relationship building as inherently dangerous and potentially corrupt. Others see the value of close collaborative partnerships and worry that harsh and inflexible enforcement will damage trust forcing members of the regulated community to withdraw from collaboration. The truth lies somewhere in between. It is only through engagement with regulators in their role of administering and enforcing regulation that the regulated community primarily ‘experience’ regulation and feel much of the associated compliance burden. Good engagement should be core business of a regulator.

Appreciating the natural tension between regulators and the regulated community the aim should be to develop mutual respect between both parties. **Defence aviation safety regulators should engage genuinely**, using formal and informal approaches whenever undertaking regulation, oversight or enforcement.

INTERACTION STYLE

Chapter 9 discussed two dimensions of enforcement style: formal/informal and facilitative/threatening. These same dimensions are applicable to any interaction not just enforcement. So with the aim of establishing mutual respect, regulatory staff should be aware of the different styles and aim to adapt accordingly as the situation requires. Some staff may find a preference for a particular style too strong. In such cases use of appropriately balanced teams or allocating staff to particular tasks is a solution.

CONSULTATION MECHANISMS

The purpose of consultation is to seek comment from affected or interested parties regarding proposals to introduce new or change existing regulations. But is consultation what is actually desired? Perhaps it is to inform, or involve, or collaborate?

Sometimes less consultation is appropriate, particularly where a rapid decision is required for the benefit of the aviation community. Consultation can be slow after all. But where consultation is desired it can sometimes be difficult for the regulated community to know the intentions of the

⁹¹ Australian Parliament, House of Representatives, Standing Committee on Transport, Communications and Infrastructure (1995), *Plane Safe Inquiry into Aviation Safety: the Commuter and General Aviation Sectors*, Australian Government Publishing Service, Canberra.



regulator. For example the disadvantage of the Notice of Proposed Rulemaking (NPRM) process is that the regulated community may fail to respond because they believe the regulator has already made up their mind. Regulators, in seeking to communicate what they are doing and why, can easily default into a process of telling.

The solution is to engage early and send clear messages as to the type of consultation the regulator expects. If the regulator is seeking real consultation regarding a regulatory change (as opposed to only informing) then engage prior to drafting the regulation, again after a draft has been prepared, and again once finalised.

Box 16: In-practice – some example consultation mechanisms

Name	Intent	Format
Discussion Paper	High level, prior to actually drafting any regulatory changes	Standalone document, titled 'Discussion Paper'
Notice of Proposed Rulemaking	For new or amendments to existing regulations	Standalone document, titled 'Notice of Proposed Rulemaking (NPRM)'
Notice of Final Rulemaking	Issued following NPRM and feedback	Standalone document, titled 'Notice of Final Rulemaking (NFRM)'
Industry Consultative Committees	To obtain focussed and coordinated industry input	Roundtable meetings once or twice a year.
Conferences and Symposiums	Coordinated input and public discussion of dedicated topics	Presentations and open discussions of various durations and timings



Box 17: In-practice – cost of Defence aviation safety regulation

The cost of Defence aviation safety regulation is not well understood. It is believed that most regulatory costs are indirect and difficult to attribute to specific regulations.

There is agreement that the cost of the regulation is not insignificant. The cost to the Commonwealth for the provision of Defence aviation materiel is over \$4 billion every year and rising. Therefore efficiency gains, however small in proportion, can make a material difference in dollar terms. Conversely, poor regulatory practices can add significant costs to the Commonwealth with little benefit to safety performance.

We know from empirical studies the drivers of burdensome and costly regulations in Defence are driven by underlying factors affecting both the regulator and regulated.

Uncertainty in the regulatory requirement leads to conservative interpretation and application by the regulated community and conservative enforcement by the regulator. Uncertainty can be introduced simply in the process of drafting regulations. That is, even assuming that all the affected parties understand and agree with the spirit of a given regulation, it is often difficult to find the exact words to capture that spirit without leaving room for interpretation (and thereby creating uncertainty). If uncertainty is created, who 'owns' it? It is lazy and most costly for the regulator to push uncertainty onto the regulated community.

Inflexibility results from overly prescriptive regulation which impedes the regulated community from doing business in the manner appropriate for their circumstances and context.

Disproportionateness means focussing too much on particular hazards or risks which leads to the regulated community having to divert their resources in a manner not consistent with their circumstances or context.

Lack of Prior Recognition involves repeating certification or compliance activities unnecessarily which drives cost for no increase in safety.

Double Treatment occurs when the same two risks or hazards are treated independently and in isolation, leading to increased administrative cost of compliance for no increase in safety.

Untimeliness by the regulator can place the regulated community in a position of uncertainty and extend periods of risk associated with waiting for regulatory decisions. Risk always increases cost.





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