



OIML BULLETIN

VOLUME LIX • NUMBER 1

JANUARY 2018

Quarterly Journal

Organisation Internationale de Métrologie Légale



OIML Certification System (OIML-CS)
launched on 1 January 2018

AUSTRALIA

The challenge of determining the economic value of metrology

N.A. CRISTAUDO, J.J. MAYO and P.E. MITCHELL,
National Measurement Institute,
Canberra, Australia

Abstract

The Australian Government is embarking on a comprehensive review of Australia's measurement laws. The aim is to modernise the framework including a shift towards a more principles-based approach. Initial analysis has raised the important question of how to quantify the economic benefit of metrology to Australia. In this paper, we focus on this question by undertaking a review of the existing economic analysis and providing an update on our current work.

The economic analysis conducted in this area has to date been limited. As a result, some of the figures relied on to quantify the economic benefit of metrology have been extrapolated beyond their original intended analysis. Some other figures are derived from studies on the general benefits of standardisation and may not capture the full scope and benefits of metrology. What value is placed on benefits such as social benefits, scientific benefits and the fundamental notion that a "modern society could not function without a systematic way of acquiring measurement data" [1].

This presents us with the challenge of how to determine the value of metrology to Australia's economy. It is important to be able to measure the value and quantitatively express the benefits of having and maintaining a legislative framework to support Australia's measurement system. It is also vital to conducting cost-benefit analysis in the area of metrology, in particular for regulated areas including trade measurement.

1 Introduction

The Australian Government is embarking upon a once in a generation review to reform Australia's measurement legislation.

When the *National Measurement Act 1960* (Cth) was first enacted one of the main drivers was to bring about the use of the metric system of measurement into Australia. Since then our country's national measurement framework has evolved to a level in which it underpins measurements that we rely upon in our daily lives; including time measurement to support high-speed global communication and satellite navigation, fuel dispensers, electricity meters, trade measurement, food quality, sports and forensic drug testing, preparation and characterisation of DNA reference materials and measurement of nanoparticles in products such as sunscreens.

While there has not been a systemic failure of Australia's national measurement system, the legislative framework is complex, overly prescriptive and outdated. To ensure that Australia's measurement framework is equipped for the future, there is a need for a more efficient legislative and policy framework to support strategic measurement capabilities and processes that will enhance business and consumer confidence, scientific advancement and provide a strong effective system that is trusted and accepted both domestically and internationally.

Whilst measurement which draws on appropriate scientific and technical expertise is central to the effective functioning of a modern economy, preliminary analysis of the review of Australia's national measurement legislation has led to asking an important question regarding how to appropriately quantify the economic benefit of metrology to Australia. The currently available analysis focuses mainly on the quantifiable benefits that a robust metrology system brings to the economy, such as the percentage of Gross Domestic Product / Gross National Product attributed to measurement in trade. What this type of analysis fails to capture are the public good arguments that result from metrology in supporting various functions in the health, environment, social, and safety sectors. The benefits of metrology in these sectors are much harder to quantify, but failing to include these benefits in an analysis of the overall economic benefit of metrology to Australia falls short of painting a complete picture of the true value of metrology.

2 Review of the framework

Although Australia's measurement system has been constantly evolving, the current legislation which underpins the system has never been reviewed to examine the appropriateness of the entire legislative and policy framework. Changes in technology, industry and consumers call for a major rethinking of Australia's

national measurement legislative framework to ensure it continues to deliver benefits which support the many sectors of the Australian economy. The review aims to align the framework with current best practice thinking, involving a move towards a more modern principles-based approach.

One of the main drivers for the review is to reshape Australia's national measurement legislative framework to better allow for innovation and productivity through greater efficiencies, while maintaining confidence in metrology for Australia as well as internationally. In order to examine what benefits the adoption of a more modern, flexible legislative framework could bring to the economy, a key consideration is to determine the current economic value of metrology to Australia to enable the Australian Government to better position measurement to provide additional benefits to the economy, now and into the future. Although professional metrologists and measurement experts may be quick to point to some key examples highlighting the importance of metrology, such as in the importance of accurate, reliable measurement to provide confidence in the claims of innovative products and services, determining the economic value it provides is trickier to quantify.

A reliable quantification of the economic value of metrology provides a basis for the determination of the appropriate level of government investment. This investment supports necessary infrastructure to maintain a functional metrology system. Infrastructure includes measurement standards and scientific equipment, highly qualified workforce, research, logistics, and accreditation [2]. A robust metrological infrastructure creates a significant cost for government. The rationale for public funding and government involvement is dependent upon establishing a case that the public good benefits justify expenditure of public funding [3]. The review will need to analyse areas that require continued spending and involvement for government and areas where savings can be made without compromising the integrity of the system.

3 The value of metrology

Certain benefits that metrology affords to the economy can be quantifiable through calculating figures such as the percentage Gross Domestic Product / Gross National Product of goods traded on the basis of measurement [4]. Although these types of studies identify the importance of metrology to society and the economy, the quantifiable indicator of benefits generated by metrology is missing [5]. These trade based economic benefits are not the only benefits that metrology offers

to the Australian economy; there are also economic benefits associated with measurement accuracy in research, innovation and productivity. The metrology framework plays a vital role in supporting industry sectors, such as health, environment, safety, and social well-being that provide a public good. The value of metrology in its role to support measurements in these sectors is much harder to quantify than it is when looking at trade transactions. The issue of placing a value on the entire metrological framework to the Australian economy is that a large portion of its value is in the public good role that it plays in innovative research and the development of new technology by universities, industry, and government, as well as the role it plays in ensuring safety and social benefits through the enforcement of laws and regulation involving technical measurement. If a value cannot be placed on the supporting role that metrology plays, then any analysis of the benefit of metrology to the economy will fall short of highlighting its true value.

4 Modern approaches

The question of how to evaluate the economic value of metrology is one that has been considered many times before. A number of studies have been conducted focusing on the economic importance of both legal metrology and the wider scope of metrology. These studies will not be discussed in any great detail here; valuable analyses of the current studies can be found in articles by Bruno Amado Rodrigues Filho and Rodrigo Franco Gonçalves [5], John Birch [4], and Peter Swann [3]. In summary their focus is on analysing the worth involved in measurements that are able to place a quantifiable value on the benefit of metrology to certain aspects of the economy e.g. trade, import/export, tax and excise. They also identify studies conducted in a number of countries that highlight the important role metrology plays in both the economy and society. A number of these studies have successfully identified the important benefits that legal metrology offers the economy, such as, reduced disputation costs, fraud prevention, consumer protection, and providing a level playing field for business. They have also discussed the various benefits of legal metrology to society including scientific development, environmental protection, improved health measures, education, and reduction of deaths and injuries through health and safety applications. While these discussions draw our attention to the benefits of metrology beyond those involving financial transactions, the missing component of these studies is a quantitative assessment of the benefits that arise.

In an analysis of the economic benefit of metrology, it is important to look to international studies, however, the metrological framework and how it is regulated will be unique to each particular country. Australia's position differs from the approach adopted by most other countries. The National Measurement Institute of Australia (NMIA) has responsibility for all aspects of metrology, including both scientific and legal metrology. NMIA is a division within the Australian Government Department of Industry, Innovation and Science. Some Australian studies, including a research paper from the Office of the Chief Economist [6], have examined the economic impact of metrology, however, these studies did not seek to assign a qualitative indicator to the wider benefits generated by metrology to the Australian economy and society.

5 The problem

It is clear from the current literature regarding the economic value of metrology that what is missing from these studies is an attempt to assign a quantitative figure to the benefits that metrology affords to the economy and society, outside of proxy figures which identify the financial value involved in measurements. The problem that this presents when attempting to place a value on the benefits of metrology to Australia as part of the review of Australia's national measurement legislation, is that any current model relied upon to calculate this value will not be sufficient to capture the full value of metrology to Australia. Although these models provide a limited quantitative analysis of the economic benefit of metrology they still provide a useful figure to justify continued expenditure on maintaining Australia's measurement framework. The review presents an opportunity to consider a full analysis of the economic value of metrology to Australia and possibly capture some of the less quantifiable aspects of metrology's benefit to the economy and society.

Currently, there does not appear to have been any work done in the Australian context regarding quantifying the public good benefits that metrology affords. Some analysis has been carried out in Australia looking into how safety enforcement requirements that utilise measuring instruments, such as radar speed devices and breathalysers, has been shown to significantly reduce the number of accidental death and injuries in Australia [7]. While this type of analysis is likely to lend itself to being able to produce a quantitative figure based on the economic saving resulting from such a decrease, there are a number of other areas where metrology provides a social or economic benefit that have not been subjected to such

analysis. Public good aspects of metrology in Australia will be much more difficult to quantify and yet they are equally as important to include in an analysis of the value of metrology as part of the measurement law review. It is important that analysis focuses on both the direct value, and the indirect/derivative value measurement has to the economy. The true challenge for the review will be to find a way to either quantify these benefits of metrology to the Australian economy, or convey their importance in a meaningful way that affords it the same weight as the quantitative economic analysis of measurement transactions.

It is accepted that the economic value of metrology is difficult to quantify as it underpins so many sectors of the economy. Australia's reliance on a robust metrological framework to support the economy and promote a harmonious society is no different to most other economies. In conducting the review of the national measurement legislation, it would be useful to have a full understanding of the economic value of metrology to Australia. This information could be useful when examining options for change to the current legislative framework in terms of the cost or benefit to Australia that would result. One way to look at the problem presented may be to consider the economic and societal cost of inaccurate measurements. The analysis could consider what the impact to the Australian economy would be where a reliable metrological framework is not maintained, or becomes outdated; what would be the flow on effect to various sectors of the economy and society, and what would be the likely costs associated with it?

6 Working towards a solution

Studies in Australia, the USA and Canada have estimated that the total value of trade transactions involving measurement (including pre-packaged goods and utility metering) accounts for at least 60 % of Gross National Income [8]. Based on these estimates, the total value of trade transactions involving measurement in Australia in 2014–15 was more than \$750 billion. This figure may be problematic for the review as the benefit is determined based on the financial value involved in measurements. Because of this, were additional analysis to be conducted, it would need to be more robust and seek to take into consideration the benefit of metrology beyond where measurement is involved in financial transactions. What could we do better or include in the analysis to get to a more accurate figure for the value of trade metrology? What value do you assign the benefit derived from 'equity in trade'?

In the context of the review of Australia's entire national measurement legislation, an economic analysis of metrology will be most useful where it is able to capture the public good benefits of metrology along with the purely fiscal calculations. This will create a much more complete picture of the economic value of metrology to Australia than that presented by analysis in the past. Ideally, any analysis conducted would strive to produce a quantitative value on the benefits of accurate measurement in sectors such as health, safety, social, environmental and energy. It may be useful to consider some of these assessments in a somewhat reverse engineered fashion, by looking at the potential cost associated with inaccurate measurement rather than trying to quantify the benefit of accurate measurement.

Some work could be done to value measurement in the health sector through analysis of research and development of innovative health solutions and technologies that rely on measurement, and looking at the potential cost associated with inaccurate measurement of pharmaceuticals and the administering of medication, including a consideration of the likely increase in death or serious health complications that could result. Similarly, in the environmental sector, it may be possible to conduct an examination of the potential cost of rectifying damage to the environment associated with inaccurate measurement of pollutants, pesticides, toxic substances and greenhouse gas emissions. Resource control is another environmental area that has been looked at in other studies that could help to build a picture of metrology's value in supporting the environment [9]. A major public policy issue is the future impacts of climate change. Although metrologists have only been marginally involved in the development of climate change public policy, greater involvement of metrology could provide increased trust and confidence in the measurements of global temperature.

Fiscal benefits associated with decreases in death and serious injury as a result of speed radar and breath analysers have been looked at in the past in Australia and similar analysis could be conducted regarding other examples of safety regulation through the use of measurement, for example weighing of transport vehicles by Australian state and territory regulators, and verified gross mass requirements for shipping containers by the Australian Maritime Safety Authority. The aerospace and transportation industry in Australia is another area that appears to not have had a thorough analysis of the benefits of metrology, and yet the costs associated with inaccurate measurement in these sectors would potentially be huge including possible loss of life or serious injury.

Electricity prices are continuing to increase in Australia and are a significant financial cost for households and businesses. Accurate measurement of electrical energy usage ensures equity in trade for

consumers. It also supports transparency for generators, distributors and retailers competing in the National Electricity Market. Phone, internet and mobile communication is another rapidly growing sector. Digital measurement of data is not currently within the remit of Australia's measurement legislation. The benefits of accurate measurement in this sector could include reduced transaction costs associated with network usage caused by billing disputes over bandwidth, data limits or data speeds. Any future analysis of the value of metrology to Australia's economy will need to focus on trying to capture these types of benefits.

A significant consideration for the review of Australia's national measurement legislation is whether an examination of the economic value of metrology to Australia is limited to legal metrology or whether it should also include an analysis capturing the benefits of scientific metrology as well. Some of the studies referenced in this article appear to narrow the value of metrology by making a distinction between legal and scientific metrology. As the review will examine all aspects of Australia's national metrological framework, a distinction should not be made to limit the scope of benefits to a specific metrological field. The analysis for the review of Australia's measurement framework will need to be undertaken to examine the overall benefit metrology has to the economy in areas such as innovation, scientific development, productivity, health and well-being to determine the economic and social value metrology provides to Australia.

7 Conclusion

There are many challenges associated with attempting to place a quantitative value on metrology to the Australian economy, many of which have been highlighted in both international and domestic studies and research papers on the topic. Despite these challenges, the question of how to reach this quantitative value continues to be asked and that is because it is well recognised that metrology provides substantial benefits to the economy and society. While some modelling has been able to value aspects of a metrological system in terms of the economic benefit it provides, these figures are not always enough to account for the total value of metrology in terms of its benefit to the economy and society. There are many benefits provided by metrology that are difficult to account for using a purely quantitative assessment, and yet there is a desire to account for these benefits in a quantitative way as part of the review of Australia's national measurement legislation. If time and effort are to be

spent conducting an analysis of the economic value of metrology to Australia, then the desire would be to attempt to account for all aspects of metrology in as much of a quantitative fashion as possible. While there are still likely to be limitations to this analysis it would be valuable for the NMIA to have a complete picture of the value of metrology to the economy and society that can be used to inform the review of the legislation as well as future analysis of metrological activities. ■

References

- [1] Poulson, B.W. *Economic Analysis of the National Measurement System*. A report from the 1972–75 Study of the National Measurement System by the NBS Institute for Basic Standards (1977).
- [2] Rodrigues Filho, B.A. *Measuring the benefits of legal metrology to place it in the National Quality Infrastructure*, OIML Bulletin LVIII (3) (2017) 19–21.
- [3] Swann, P. G.M. *The Economic of Metrology and Measurement*. Report for National Measurement Office, Department for Business, Innovation and Skills. Innovative Economics Limited. 2009.
- [4] Birch, J.A. *Benefits of Legal Metrology for the Economy and Society*, A study for the International Committee of Legal Metrology. OIML Expert Report E 2 (2003).
- [5] Rodrigues Filho, B.A. and Gonçalves R.F. *Legal metrology, the economy and society: A systematic literature review* Measurement 69 (2015) 155–163.
- [6] Robertson, K. and Swanepoel J.A. *The economics of metrology* Research Paper 6/2015 Office of the Chief Economist (2015).
- [7] Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2014, *Impact of road trauma and measures to improve outcomes*, Report 140, December, Canberra.
- [8] Birch, J.A. *The economic importance of legal metrology in pre-packaging* OIML Bulletin XLVIII (1) (2007) 19–24.
- [9] Kleppin, R., et al. *Resource Control by use of belt weighers in the fishing industry* OIML Bulletin XXXVIII (4) (1997) 24–28.

The Authors

N.A. Cristaudo, J.J. Mayo and P.E. Mitchell

National Measurement Institute
 Measurement Law Review Section
 GPO Box 2013
 Canberra ACT 2601
 Australia

measurementlawreview@industry.gov.au