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ALGORITHM ASSESSMENT REPORT

Te Tari Taiwhenua
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New Zealand Government

CONTENTS

EXECUTIVE SUMMARY 4

BACKGROUND 5

What are algorithms? 7

Government algorithms 8

What are machine learning and Artificial Intelligence? 8

Assessment of Government algorithms 9

Principles for the safe and effective use of data and analytics 9

Process 10

Participating agencies 10

GOVERNMENT DATA SYSTEM AND ALGORITHM USE 11

Children and young people 11

Case study – School transport 12

Case study – Young people not in employment, education or training 14

Economy and employment 15

Case study – Automatic refunds 16

Case study – Visa triage 17

Safety and security 17

Case study – Family violence risk assessment tools 20

Case study – Risk of Reconviction/ Risk of Re-imprisonment 21

Health and Injury 22

Case study – Clinical Prioritisation Access Criteria 22

Research and policy development 24

Case study – Population projections 24

ASSURANCE AND SAFEGUARDS 26

Assessment against the principles for safe and effective use of data and analytics 26

Principle – Deliver clear public benefit 26

Example of good practice Data protection and use policy 28

Principle – Maintain transparency 28

Principle – Understand the limitations 28

Example of good practice Privacy, Human Rights and Ethics Framework (PHRaE) 29

Principle – Retain human oversight 29

Principle – Data is fit for purpose and a focus on people is retained 29

CONCLUSION AND RECOMMENDATIONS 30

Algorithm use 30

Automated decision-making 30

Recommendations – Human oversight 32

Development and procurement 32

Recommendations – Development and procurement 34

Information and transparency 34

Recommendations – Information and transparency 34

Review and safeguard 34

Recommendations – Review and safeguard 35

Sharing best practice 35

Recommendations – Sharing best practice 35

Further assessment 35

APPENDIX: OPERATIONAL ALGORITHMS DESCRIBED BY PARTICIPATING AGENCIES 36

01
EXECUTIVE SUMMARY

Algorithms have an essential role in supporting the services that government provides to people in New Zealand and in delivering new, innovative, and well targeted policies to achieve government aims.

All of the algorithms considered in this review are embedded in policies that deliver clear public benefit, ranging from protecting New Zealand from external risks and threats, to streamlining processes and improving efficiency. The value of employing this technology ranges from the immediate, such as reducing costs to the taxpayer and speeding up the delivery of services, to the indirect, such as increasing New Zealand's productivity and improving the lives of people by reducing social harm.

The opportunities afforded by new and evolving technology also bring fresh challenges. The government must exercise good practice in the way that it collects, manages, and uses data to retain public confidence. Robust safeguards must be used to identify algorithmic bias, protect individual privacy and ensure appropriate levels of transparency.

The Minister of Statistics and the Minister for Government Digital Services have commissioned the Government Chief Data Steward and the Government Chief Digital Officer to assess existing algorithms and their uses across government agencies. This report provides a summary of the self-reported information submitted by 14 government agencies about the algorithms that they use to deliver their functions. It also considers the use of these algorithms against the principles for the safe and effective use of data and analytics published by the Privacy Commissioner and the Government Chief Data Steward.

This report finds that while agencies are applying a range of safeguards and assurance processes in relation to the use of their algorithms, there are also opportunities for increased collaboration and sharing of good practice across government. There is also scope to ensure that all of the information that is published explains, in clear and simple terms, how algorithms are informing decisions that affect people in significant ways.

Humans, rather than computers, review and decide on almost all significant decisions made by government agencies. As agencies continue to develop new algorithms, it's important to preserve appropriate human oversight and ensure that the views of key stakeholders, notably the people who will receive or participate in services, are given appropriate consideration.

The government commitment to Treaty-based partnership should also be reflected, embedding a te ao Māori perspective into the development and use of algorithms.

In addition to connecting expertise across government, agencies could also benefit from a fresh perspective by looking beyond government for privacy, ethics, and data expertise. This could be achieved by bringing together a group of independent experts that agencies could consult for advice and guidance.

The findings of this report provide an opportunity for agencies to review and refresh the processes they use to manage algorithms and will help to shape the work of the Government Chief Data Steward and the Government Chief Digital Officer to promote innovation and good practice across the data system.[1]

1 The flow of data between people, government, and organisations, and the checks and balances that are in place to safeguard this.

02
BACKGROUND

Harnessing the power of data can reveal insights and create exponential benefits in many areas of life. It can even save lives. In the 19th century, epidemiologist John Snow famously plotted the location of cholera cases in London's Soho district to identify that the outbreak was caused by contamination of a local water pump. This idea provided the foundation for how we identify, track, and prevent disease all over the world today.

Since that time, we've increasingly used data to improve our daily lives. Through data analysis, we can make more informed choices about how we can best spend our time and resources. And as technology has advanced, the amount of data collected has increased. Analytical tools have also become more sophisticated.

Computer algorithms, a procedure or formula for solving a problem or carrying out a task, are now a fundamental element of data analytics. They've been used in everyday life since the mid-20th century, controlling everything from elevators to traffic lights that predict our likely vehicle movements to reduce travel times.

Algorithms have been a cornerstone of financial markets and investment, a common fixture in sports analysis and strategy, and underpin the systems we rely on to make forecasts about the likelihood of future events, such as population trends or tomorrow's weather.

Algorithms have evolved as technology and data analysis methods have advanced, progressing beyond the simple encoding of rules. Such algorithms can now model complex outcomes including, in some cases, human behaviour. Marketing and advertising domains have been relying on this type of modelling for many years. These algorithms use statistical methods and predict likely outcomes.

In the past, a simple series of operations for defining a process may have been considered an algorithm. Precise definitions meant that a computer could calculate a result very quickly, leading to great increases in productivity. Such processes are still in widespread use today – we might call them automated business rules. One example is a system that automatically calculates weekly pay when given hours worked and pay rates.

> ***"Algorithms have evolved as technology and data analysis methods have advanced, progressing beyond the simple encoding of rules. Such algorithms can now model complex outcomes including, in some cases, human behaviour.***

Dianne Macaskill, General Assembly Library statistician. Photograph by Ian Mackley.

> ***...techniques have been developed that allow computers to use previously collected data and learn statistical rules that can predict the likelihood of future outcomes.***

With more data and as more advanced statistical uses of data have evolved, techniques have been developed that allow computers to use previously collected data and learn statistical rules that can predict the likelihood of future outcomes. These techniques are known by terms such as machine learning, deep learning, and Artificial Intelligence. They can be differentiated from earlier types of algorithms because they make predictions of likely outcomes, and don't merely give well-defined, precise results. For example, a bank might use an algorithm to calculate a credit risk score, based on a range of data about a person's past financial management and earnings.

What are algorithms?

There are a range of definitions used to describe algorithms. For the purposes of this report, participating agencies were asked to provide information about three categories of algorithm:

- **Operational algorithms:** These impact significantly on individuals or groups. These analytical processes interpret or evaluate information (often using large or complex data sets) that result in, or materially inform, decisions that impact significantly on individuals or groups. They may use personal information about the individuals or groups concerned, but do not need to do so exclusively.
- **Algorithms used for policy development and research:** These include analytical tools used to analyse large and varied data sets to identify patterns and trends, to support policy development, forecast costs, and to model potential interventions. For this review the key distinction between these and operational algorithms is that they have no direct or significant impact on individuals or groups. They may inform policy development but have no significant or direct impact on service delivery. These algorithms are not the focus of this review, but agencies were asked to describe these in general terms.
- **Business rules:** These are simple algorithms created by people that use rules to constrain or define a business activity. They make determinations about individuals or groups, without a significant element of discretion. This review asked agencies to provide an illustration of their use of these types of algorithms but did not seek an exhaustive list of such processes.

This report focuses primarily on operational algorithms, partly because of their potential sophistication and complexity, but primarily because of the role they can play in decisions that impact significantly on individuals or groups.

Operational algorithms allow the delivery of a much greater number of efficient services, including entirely new ways of doing things. For example, New Zealand tertiary education providers are using algorithms to predict the risk of students failing to complete their studies, so they can better target individual support.[2] New Zealand farmers increasingly use algorithms to show them what is required to improve soil performance, understand hydrology, and better target their efforts to protect crops like kiwifruit from threats such as disease or pests.[3]

However, there are also challenges associated with the increasingly widespread application of algorithms. The output of an algorithm will only be as good as the data it draws upon, and without high quality data, and appropriate data management, the accuracy and predictive ability of any algorithm can be compromised.

When data relates to people, it's also essential that individual privacy and the purpose for which the data is collected is considered during the analytical process. If the process is not transparent, people are less likely to trust the decisions that are made as a result, and may not wish to continue sharing their personal information.

There can also be a risk of bias. Because computer algorithms and computer programmes are created by humans, there is a possibility that human assumptions and biases, often already present in human decision-making, are unwittingly incorporated into computer programmes by those who create them.

Algorithms can make biases harder to detect. Deciphering the code used to create an algorithm often requires technical expertise and proprietary code is not always made public. In addition, algorithms often draw on historical data, which may reflect biases that are not immediately apparent. There is a risk that algorithms that use biased data could further reinforce inequality.

2 https://ako.ac.nz/knowledge-centre/predictive-working-tool-for-early-identification-of-at-risk-students/predictive-working-tool-for-early-identification-of-at-risk-students/

3 https://www.cms.waikato.ac.nz/~fracpete/pubs/2014/Hill_et_al_data_mining_2014.pdf

Government algorithms

Government agencies use data to help underpin the services provided to people in New Zealand. Data analysis can lead to better policies, supported by evidence, that will make the greatest difference to people in New Zealand.

Algorithms can also create efficiencies that may save taxpayer money, and lead to increased investment in areas of critical importance for New Zealand. In some cases, using algorithms is the only efficient way to process the large quantities of information necessary for the operation of modern government services.

The increased sophistication and number of algorithms allows for increasingly linked government services, a better understanding of what works and for whom, and more opportunities for collaboration and efficiency gains. These represent tangible benefits for all people in New Zealand.

Digital tools, such as algorithms, are the engine of better government service delivery. They enable services to be joined up seamlessly around customers, clients, and businesses to better meet their needs. They can make it easier to engage with government.

However, the opportunities afforded by these advances also bring fresh challenges. It's now more important than ever to ensure good practice in data collection and management, to build safeguards to identify algorithmic bias, and to protect individual privacy through the safe use of data and analytics.

What are machine learning and Artificial Intelligence?

As with the definition of algorithms, there is no universally agreed definition for these terms, and often they are used interchangeably. For the purposes of this report, machine learning algorithms are techniques that allow computers to learn directly from examples, data, and experience, finding rules or patterns, and employing methods that a human programmer did not explicitly specify.[4]

Artificial Intelligence has been described as advanced digital technologies that enable machines to reproduce or surpass abilities that would require intelligence if humans were to perform them.[5]

> ***Digital tools ... enable services to be joined up seamlessly around customers, clients, and businesses to better meet their needs. They can make it easier to engage with government.***

4 http://omidyar.com/sites/default/files/file_archive/Public Scrutiny of Automated Decisions.pdf

5 https://aiforum.org.nz/wp-content/uploads/2018/07/AI-Report-2018_web-version.pdf

Assessment of Government algorithms

The Minister of Statistics and the Minister for Government Digital Services have commissioned the Government Chief Data Steward and the Government Chief Digital Officer to assess existing algorithms and their uses across government agencies.

This report focuses, in particular, on operational algorithms that result in or materially inform decisions which impact significantly on individuals or groups.

This project is the first of its kind in New Zealand – a cross-government analysis of the development and use of algorithms in 14 agencies, many of whom interact with people in New Zealand every day. This is the first step to increasing the transparency and accountability of government algorithm use across the entire government data system.

The review provides an overview of how the participating government agencies are using algorithms to support their work, how these have been developed, and the safeguards that are in place. It considers the use of algorithms in the context of the principles for safe and effective use of data and analytics, and suggests where there may be scope for further improvements in algorithm development and management practices.

The review also identifies good practice within agencies, and highlights opportunities to support agencies using algorithms in decision-making, with the aim of increasing public awareness and confidence around their use.

Principles for the safe and effective use of data and analytics

The Privacy Commissioner and the Government Chief Data Steward recently released six principles for the safe and effective use of data and analytics by government agencies. These principles are designed to support transparency and promote a best-practice use of data and analytics for decision-making.

The principles are:

- Deliver clear public benefit – it's essential government agencies consider, and can demonstrate, positive public benefits from collecting and using public data.
- Maintain transparency – transparency is essential for accountability. It supports collaboration, partnership, and shared responsibility.
- Understand the limitations – while data is a powerful tool, all analytical processes have inherent limitations in their ability to predict and describe outcomes.
- Retain human oversight – analytical processes are a tool to inform human decision-making and should never entirely replace human oversight.
- Ensure data is fit for purpose – using the right data in the right context can substantially improve decision-making and analytical models, and will avoid generating potentially harmful outcomes.
- Focus on people – keep in mind the people behind the data and how to protect them against misuse of information

Participating agencies were asked to provide information about the three categories of algorithm as previously described. However, this report focuses on operational algorithms that result in, or materially inform, decisions that impact significantly on individuals or groups.

By concentrating on the areas that most directly and significantly impact on the lives of people in New Zealand, we aim to provide insight into a complex and significant area of government operations.

Process

In June and July 2018, participating agencies were asked to respond to a standard series of questions related to their use of algorithms, and provide examples to illustrate that use.

Participating agencies

The following government agencies participated in this review:

- Accident Compensation Corporation
- Department of Corrections
- Department of Internal Affairs
- Inland Revenue
- Ministry of Business, Innovation and Employment (including Immigration New Zealand)
- Ministry of Education
- Ministry of Health
- Ministry of Justice
- Ministry of Social Development
- New Zealand Customs Service
- New Zealand Police
- Oranga Tamariki
- Social Investment Agency
- Stats NZ

03

GOVERNMENT DATA SYSTEM AND ALGORITHM USE

The following section describes how participating New Zealand government agencies use data and algorithms to deliver services designed to improve the lives of people in New Zealand.

While not exhaustive, this section highlights the diversity and scope of everyday government services and tools, drawing on data and powered by algorithms. Examples are provided for context, and to illustrate specific algorithms that may represent a range of similar processes.

> ***Birth registration is one area in which the government uses operational algorithms on an individual basis. In order to help new parents access financial support and social services, data from hospitals and midwives is sent to the Department of Internal Affairs to provide preliminary registration of a birth.***

Children and young people

From birth, through education, and into employment, children and young people interact with government agencies in a variety of ways. Because government services need to adapt to meet demand, much of the data collected relating to children and young people is used to forecast the future need for services and to provide a high-level trend analysis, rather than for individual level decision-making.

Birth registration is one area in which the government uses operational algorithms on an individual basis. In order to help new parents access financial support and social services, data from hospitals and midwives is sent to the Department of Internal Affairs to provide preliminary registration of a birth. In 2016/17 there were 59,685 birth registrations.

This process also enables the department to send reminder letters to parents who have not yet registered a birth. Birth registration is a pre-requisite for recording citizenship and accessing a passport. By registering through the Smart Start service, new parents also have the option of obtaining an IRD number for their child, applying for Best Start payments, and notifying the Ministry of Social Development about their new child.

CASE STUDY

School transport

Challenge: Organising school bus services for approximately 72,000 eligible school children across the country is no small feat. More than 2,200 school bus routes are used twice every school day throughout New Zealand.

Traditional route reviews were taking several weeks to complete using mapping tools to manually plot bus routes, with printed maps and colour-coded highlighter pens. The reviews were not keeping pace with changes in student eligibility or in transport data that affected bus routes, such as student locations or changes to the road network.

Solution: To improve the robustness and nationwide consistency of eligibility testing, as well as the optimisation of route design in both accuracy and time, the Ministry of Education uses an algorithm to develop, standardise, automate, and maintain school bus routes.

In June 2016, the Ministry of Education introduced two pieces of software to calculate student eligibility for transport assistance and to develop the most efficient routes for school buses. The first was an eligibility assessment function using an algorithm that effectively put school transport eligibility criteria 'on a map' and the second piece was a School Transport Route Optimiser (STRO) that uses the eligibility assessments to design optimal distance-based bus routes. Using software under license, the algorithm plots where students live, based on data held by the Ministry, and calculates the most effective route for pick-up and drop-off of students, drawing on up-to-date information about road changes and speed limits.

Outcome: The STRO has made bus travel more efficient for children and their communities. The new eligibility assessment algorithm, coupled with STRO, has cut the time required to review an individual route from up to four weeks, to only four hours. By placing the STRO algorithm and eligibility assessment at the heart of the route assessment process, the project has led to significant efficiencies in the time required to plan bus routes, and in bus travel times, meaning a reduction in greenhouse gases. There has also been a saving of $20 million a year to the taxpayer.

All children and young people in New Zealand are likely to be involved in the education system for a period in their lives. Currently there are more than 1.5 million children, young people, and students enrolled in some part of the education system.

When children enter early childhood education or school, the Ministry of Education collects information to help make resource allocation decisions and to help monitor the equity of student achievement and engagement. The data collected includes:

- information about the age, gender, and ethnicity of students
- details about attendance, discipline, and engagement of school students
- enrolment and attendance at early childhood education
- enrolment and course completion in tertiary study.

Collecting this data is part of a system that supports early learning services, schools, and tertiary providers to make decisions about how to allocate their resources in order to deliver education designed to best support students.

The Ministry of Education does not use algorithms to make operational decisions about individual children or young people, however, indirect operational decisions are made that may impact children. The information that is collected about pupils and students is grouped together to inform decisions about particular schools and other education services. Decisions about specific individuals are the responsibility of the relevant schools or education providers.

Aggregated information, including data filtered by school or education provider, sex, region, and ethnicity, is published online. This data provides a high level of transparency about trends over time. It also highlights inequities, enabling the public to have informed conversations with schools and the education providers who make decisions about the education of children and young people.

Information about other aspects of education is held by other crown entities. For example, the New Zealand Qualifications Authority holds data related to individual qualification attainment and the Education Council of Aotearoa New Zealand holds information on teacher registration.

The Government is committed to supporting any child in New Zealand whose wellbeing is at significant risk of harm now, or in the future. It is estimated that two in ten children and young people in any birth cohort will come to the attention of the statutory care and protection or youth justice systems in childhood. Of these, one-quarter will require intensive support and a statutory response.[6]

Oranga Tamariki (Ministry for Children) collects a wide range of information about vulnerable children and uses this to provide services such as arranging clinical needs diagnoses and arranging referrals based on the results. The information also informs decisions about matching children with caregivers. Data collected in this way is analysed so that case-loads can be managed effectively by frontline staff. In 2017, the agency received 158,900 referrals, from which it was determined that 33,000 children and young people required further assistance.

6 Based on the Modernising Child, Youth and Family Expert Panel analysis of the Ministry of Social Development's 2012 study.

It is estimated that two in ten children and young people in any birth cohort will come to the attention of the statutory care and protection or youth justice systems in childhood.

CASE STUDY

Young people not in employment, education or training

Challenge: The unemployment rate for young people (15–24-year-olds) who leave school, but do not enter employment, education or training is more than double the rate of the next highest age group – those aged 25 to 34. Young Māori and Pasifika are particularly represented in this group.

Solution: Established in 2012, Work and Income's Youth Service, NEET, uses an algorithm to help identify those school leavers who may be at greater risk of long-term unemployment, and proactively offers them support in terms of qualifications and training opportunities.

The algorithm considers factors such as:

- demographic information
- whether a young person's parents were on a benefit
- the school history of a young person (including educational achievement, reason for leaving school, and truancy history)
- whether a young person has ever been the subject of a notification to Oranga Tamariki.

Each of these factors has been shown to affect whether a young person may need support. The algorithm produces risk indicator ratings for school leavers: high (top 10 percent), medium (next 10 percent), low (next 20 percent), or very low (final 60 percent). The rating indicates the level of support they might require and determines the funding for providers.

A young person with more of these factors, or where one or more factors has a higher value (such as multiple truancy or multiple notifications), will have a higher risk indicator rating.

The algorithm refers the high, medium and low risk (40 percent) school leavers to NEET providers who make contact and offer assistance. The data collected by these providers is incorporated into the model to improve future accuracy.

Outcome: Since 2012, more than 60,000 young people have accepted assistance from the service. One-third of these have been offered the service through the algorithm that has automated the referral system.

NEET has proved to be most effective for those with a high-risk rating, resulting in improved education achievements and wellbeing, and less time on a benefit, compared with those who did not use the service.

Oranga Tamariki does not currently deploy any operational algorithms for use in operational decision-making. The Oranga Tamariki system is a case management system informed by professional social work practice and input. The agency does conduct research to guide forecasting and to support policymaking, as well as using data in performance reporting.

Other agencies also collect data on young people to support positive interventions. The Ministry of Social Development uses an operational algorithm, based on machine learning, to inform decisions about which services are best suited to support young people not in employment, education or training.

Reserve Bank of New Zealand

Economy and employment

Government agencies have an important role in monitoring labour market trends, including immigration and welfare settings, and supporting people to undertake training and education, and obtain employment. Of New Zealand's population of approximately 4.8 million people, around 3.8 million are of working age (15 years and over) and 2.7 million are participating in the labour force (working, or actively looking for work).

In order to pay for services and fund investment, the Government relies on a robust, efficient, taxation system. This is fundamental to improving the economic and social wellbeing of people in New Zealand. In 2016 nearly 3.7 million people paid Pay As You Earn (PAYE) tax or filed a personal tax return (including those who are self-employed and those earning interest on investments), while nearly 203,000 employers filed over 2 million employer monthly schedules with PAYE deductions for employees. In the same period 396,000 company tax returns were filed and 3 million Goods and Services Tax (GST) returns were submitted.

Inland Revenue collects, analyses, and holds data to ensure tax obligations are met and entitlements and payments (such as Working for Families tax credits, child support, and paid parental leave entitlements) are disbursed by government. Data is collected directly from people (when beginning a new role) and employers (through regular returns), as well as third parties, including government agencies who maintain employment information about people.

Algorithms are used to make large numbers of automated calculations regarding payments and refunds, and to identify opportunities to improve people's engagement with Inland Revenue by offering additional information and support.

The Ministry of Social Development collects information to support decision-making related to providing income support, connecting people with employment, or facilitating education and housing services to those in need. Some of this information is collected in the first instance by other entities, such as other government agencies and medical professionals. Sometimes the original data is processed with additional information to create new data that helps to provide broader insights than would be possible with the original material alone. Around 30 percent of New Zealanders receive some type of financial support in a year. For the financial year ending June 2018 there were:

- 277,410 working-age people (18–64-years-old) in receipt of main benefits
- 92,642 people (18–64-years-old) with Supported Living Payments
- 753,319 people in receipt of New Zealand Superannuation (65+)
- 60,903 people (all ages) receiving supplementary support.

The Ministry of Social Development uses automation to make processes more efficient. These processes are examples of the simpler type of algorithm, and are based on business rules. However, case managers can apply discretion if they believe there are other circumstances that should be taken into account that are not covered by business rules (for example, in processing hardship applications).

CASE STUDY

Automatic refunds

Challenge: The current process of finalising a customer's tax each year is costly in terms of the time and effort invested by the customer. Inland Revenue holds most of the information necessary to process a person's tax but the current process results in a delay in receiving any potential refund.

Solution: To solve this problem, Parliament is considering implementing a new system that will calculate the tax position for the customer where they are reasonably confident of the customer's income. Using an algorithm, Inland Revenue will complete a calculation on the customer's behalf and issue an immediate refund or notice of outstanding tax. Where the system is not satisfied, the taxpayer will be asked to provide any missing information.

Outcome: Inland Revenue estimates that between 2.5 and 3 million taxpayers will have to do little or nothing when their next tax return is due. An additional 750,000 taxpayers will receive refunds and they will not incur any costs to obtain the refund.

Immigration New Zealand uses a range of operational algorithms to manage risk to New Zealand and ensure that the approximately 6.7 million travellers who pass through the border annually receive speedy, consistent, immigration decisions. Just over one in four people in New Zealand's workforce are migrants, and tourism is now worth $12.9 billion per year to the New Zealand economy.

CASE STUDY

Visa triage

Challenge: Immigration New Zealand (INZ) processes more than 800,000 visa applications a year from offices around the world. As part of the Vision 2015 transformation programme, investments were made by INZ to improve global consistency of their processes, including risk assessment.

Solution: INZ developed a triage system, including software that assigns risk ratings to visa applications. The risk rating provides a guide to the level of verification to be performed by an Immigration Officer on an application, but does not determine whether an application is approved or declined. An Immigration Officer still assesses and decides every application.

The risk rating applied to a visa application is determined by the application of multiple risk rules working together. The risk rules are developed using a range of qualitative and quantitative information and data. For example, one of the "high risk" rules applies if the applicant does not hold an acceptable recognised travel document.

Risk rule changes are overseen by a tiered governance model. A Triage Reference Group assesses risk rule changes, and refers any significant changes to the rules or to the triage model to the Operational Systems Integrity Committee (OSIC). OSIC reports to the Immigration Leadership Team.

Outcome: All temporary entry visa applications are assessed in the triage system and immigration officers follow verification guidelines based on the risk rating to assess applications. This has increased consistency across visa processing offices, improved processing times, and allowed attention to be focused on higher-risk applications. This allows staff to identify new and emerging risks, and see where risks are no longer present.

The broad categories of operational algorithms in use by Immigration New Zealand include:

- biometric and biographic matching
- customer segmentation based on risk
- customer screening based on eligibility/alerts/ watchlists (for example Interpol alerts)
- case prioritisation.

These algorithms are used to process passengers travelling to New Zealand in advance, and support decisions related to the granting of a visa. This analytical support allows staff expertise to be targeted to areas of greatest need.

Safety and security

A safe and effective border provides protection and security and prevents social harm and costs to New Zealand. There is a significant overlap between the respective work of border agencies (Immigration New Zealand, the New Zealand Customs Service and the Ministry for Primary Industries), and a joint border analytics team was established in late 2016 to support a more integrated approach to border management. The team shares information, software, and analytical capability to gain new insights into border risk.

The New Zealand Customs Service screened 41.76 million mail items, and risk-assessed and processed 13.98 million travellers and nearly 496,000 imported sea containers in 2017/18. All arriving and departing passengers and goods are subject to screening and assessment processes that employ some form of operational algorithm and subsequent analysis.

These algorithms are developed by Customs, drawing on previous data and other assessments, including intelligence reports. The algorithms are used to automatically process incoming information relating to passengers and goods according to a set of rules relating to the characteristics of the passengers, goods, and craft known as a targeting profile. If the profile indicates potential risks that are considered to be significant, the information is reviewed by a Customs officer who makes further inquiries, if appropriate.

New Zealand Customs Service

The algorithms make travel through the border more efficient and less time-consuming for the majority of passengers (for example, 7.25 million air passengers were processed using eGate in 2017/18) and in 2017/18 the algorithms contributed to:

- the prevention of an estimated $1.34 billion in potential harm (social and economic costs) through the seizure of illicit drugs
- the prevention of an estimated $20.75 million in potential harm through interceptions at the border of other unlawful activity (such as seizures of objectionable material and firearms, and attempted evasion of duty)
- the interception of an estimated 30,560 individual counterfeit items at the border.

Review and refinement of algorithms by the New Zealand Customs Service between 2014 and 2016 led to significant gains. These included a 245 percent increase in the volume of illicit drugs seized by mail and better targeting of resources, while there was a 45 percent reduction in the number of legitimate consignments inspected at a time when trade levels increased by 57 percent.

Department of Internal Affairs

Algorithms are also used by the Department of Internal Affairs to process passport applications. The Department received 658,802 applications in 2016. Over the same period, 2,315 New Zealand passports were reported stolen, and immediately placed on the lost and stolen database held by Interpol.

To ensure that applicants receive efficient service, algorithms, including automated facial recognition testing, are employed as part of 140 separate checks necessary to process passport applications. This process allows approximately 40 percent of passport renewals to be automatically approved, while any application that includes errors, or meets a pre-identified risk threshold, is referred to passport staff and processed manually.

The Ministry of Justice collects data to support the efficient delivery of justice services. This includes data on legal aid, the public defence service, fines collection, contact centre transactions, and finance.

Court information about individual cases remains under the control of the court, however anonymised and aggregated information from individual cases is used by the Ministry of Justice to support policy formation, statistics, and research.

Operational algorithms are used to support frontline Ministry of Justice staff to make decisions about the collection of fines and reparation. These algorithms help process approximately 500,000 cases each year, using data based on people's past events and history to recommend a relevant intervention. All final decisions about actions and interventions are made at the discretion of a Collections Registry Officer.

Every day, on average, the New Zealand Police make more than 2,000 traffic stops, respond to more than 3,000 events, and prosecute more than 200 cases. During their work the Police collect operational and administrative data to support effective crime prevention, response, investigation, and prosecution.

Key data collected and maintained by the Police includes data about:

- victimisations
- police proceedings
- police demand and activities
- communication centre transactions.

This data is analysed and used to support the effectiveness and efficiency of operations, measure operational and system performance, inform improvement opportunities, and support policy development and interventions. Anonymised and aggregated information about crime is used by Police to support official statistics, research and evaluation.

Police currently use some operational algorithms to support the assessment frontline staff make during an initial scene attendance and for follow-up safety actions. These algorithms form part of the assessment (along with an officer's interaction with the people involved and any investigation that has been undertaken).

These algorithms have been designed to support informed decision-making, raise the awareness of risks people are exposed to, support preventive actions, and improve the safety of the people involved. While these operational algorithms indicate a level of concern for safety or risk, all final decisions about actions and interventions are made at the discretion of police officers.

> ***"These algorithms have been designed to support informed decision-making, raise the awareness of risks people are exposed to, support preventive actions, and improve the safety of the people involved.***

CASE STUDY

Family violence risk assessment tools

Challenge: Each year, approximately 12 women, 10 men and a number of young children are killed by a family member. The New Zealand Police attend over 100,000 events of family harm a year or approximately 300 every day.

Solution: The Police support decision-making by their frontline staff by using two algorithms that assess the risk of future offending. The Static Risk algorithm calculates the probability that a family violence perpetrator will commit a crime against a family member within the next two years, based on data held in police systems such as gender, past incidents of family harm, or criminal history.

The Dynamic Risk Measure algorithm draws on leading research to make an assessment based on the current circumstances against a range of safety concerns.

Both algorithms are complementary and used only in the context of a family harm investigation. They are part of a suite of tools and processes that inform an assessment carried out by a police officer.

Outcome: These tools inform decision-makers about risk by using relevant data and research to support human judgement, in what can often be an extremely complex and challenging situation for Police, and victims and their families.

The Department of Corrections collects and analyses data in relation to individual offenders who come under their management because of either custodial remand, being a sentenced prisoner, or as an offender subject to community services or orders. During an average year 15,000 people start a period in custody on remand, and 9,000 start a prison sentence. More than 36,000 people start a community sentence or order, with most completed within 12 months.

The Department of Corrections collects individual information including criminal history, current offences, convictions and sentences, demographic data, and other information relevant to the individual's management. The department also uses data from other agencies including the Police and Ministry of Justice. One operational algorithm is used for decision-making (the Risk of Reconviction/Risk of Re-imprisonment algorithm) and algorithms are also used in a non-operational way to evaluate the outcomes of rehabilitation programmes.

CASE STUDY

Risk of Reconviction/Risk of Re-imprisonment

Challenge: Almost half (49 percent) of all released prisoners are re–imprisoned within five years, generating costs to the taxpayer of approximately $650 million over the following five years. Research has shown that even simple risk scales (ie a checklist of risk factors) invariably outperform the clinical or professional judgements of trained experts and experienced correctional staff when making predictions about future offending.[7]

Solution: The Risk of Reconviction/Risk of Re-imprisonment algorithm calculates the probability that an individual offender will be reconvicted and re-imprisoned for new offending within five years following the date of the assessment. The algorithm draws on data from around 30 individual variables including:

- demographic data (age and sex)
- age at first offence
- frequency of convictions
- number of court appearances and convictions
- current offence category (for example, violent, sexual, drugs)
- number of convictions in each crime category
- sum of seriousness ratings for all crimes (defined by the average length of sentence in days imposed by offence type)
- weighted past seriousness measure (places greater weight on the seriousness of most recent offence)
- maximum serious measures for the past time period
- mean serious measures for the time period
- number of previous imprisonment sentences
- maximum sentence length handed down to offender in past (years)
- total estimated time (years) spent in prison
- time at large (length of offenders most recent time at large).

Ethnicity is not a variable in the algorithm. The variables used are extracted from criminal history and converted by the algorithm into the risk score.

This is one of a number of considerations that may influence how an offender is managed over the course of their sentence or order in relation to:

- level/intensity of management required while on a community sentence
- eligibility for rehabilitation programmes
- prisoner security classification
- release on parole.

The risk scores generated by the algorithm are considered together with the opinions of relevant qualified professionals including case managers, Probation Officers, and psychologists.

7 Grove, W.M., Zald, D.H., Lebow, B.S., Snitz, B.E., & Nelson, C. (2000). Clinical versus mechanical prediction: A meta-analysis. Psychological Assessment, 12(1), 19–30.

Health and Injury

Good health supports everyone's ability to engage fully in all aspects of life, and at some point the majority of people will interact with a primary health provider (such as a general practitioner, pharmacist, or other health professional).

The health sector generates a large quantity of data from the interactions people have with different health providers, both private and public. However only a small proportion of this data is provided to the Ministry of Health, while the balance is maintained by district health boards, primary health providers, allied health providers, and health non-governmental organisations.

The Ministry of Health currently maintains more than a dozen databases which hold:

- hospital records
- records of outpatient events and emergency department events
- records of elective surgeries
- information on patient flow through secondary services
- records of secondary mental health events
- records of deaths and their causes
- cancer registrations
- records of community pharmaceuticals dispensed
- details of laboratory tests
- enrolments with primary care organisations
- records of maternity care and birth events
- immunisation data
- details of a range of screening programmes.

Aggregated data is primarily used for performance monitoring (including service quality and coverage), policy development, the production and publication of statistics, and to support health research. This data is shared extensively throughout the health sector to enable sector organisations to benefit from a nationally consistent data collection.

Health is a devolved sector where services are provided by regional and local organisations such as district health boards, primary care providers, allied health providers and health NGOs. In some cases algorithms are used by these providers to improve the consistency of services provided.

CASE STUDY

Clinical Prioritisation (Access Criteria)

Challenge: The process by which people were previously put on waiting lists to receive elective health services, and the order in which they were treated, was inconsistent. Elective health services, or electives, are medical or surgical services that will improve quality of life for someone suffering from a medical condition, but these services can be delayed because they are not required immediately.

With the old waiting lists, many people did not know when they would receive treatment. Some people received treatment because they had waited a long time, other patients considered "urgent" waited a long time despite "less urgent" patients receiving significantly earlier treatment.

Solution: Clinical Prioritisation Access Criteria (CPAC) is a suite of tools developed to provide a more equitable and consistent way of national prioritisation. CPAC was iteratively developed by clinical working groups and has been designed to rank the treatment of individual patients based on clinically developed criteria.

Outcome: These tools facilitate the treatment of all patients within four months, more quickly providing a more consistent treatment for patients. Demand for electives is increasing for a number of reasons, including the ageing of New Zealand's population and the increased range of procedures available due to new technology.

New Zealand's Accident Compensation Corporation administers the accidental injury scheme that provides compensation and rehabilitation to people in New Zealand who have suffered a personal injury, as well as focusing on injury prevention. ACC provides cover for approximately 2 million claims per year, at a cost of nearly $4 billion.

Information about claimants and their injuries is collected at the point of registration and client outcome data is used to evaluate operational effectiveness and identify opportunities for improvement. ACC maintains a contractual relationship with a range of healthcare providers, so data related to their interactions with ACC clients is collected and used for evaluation of these services.

ACC uses algorithms based on claims data, built up over many years, to help understand and personalise clients' support needs. This allows ACC to proactively assist those clients who need higher levels of support to return to independence. Algorithms are also used to identify waste and fraud through a series of pilot projects, which identify cases for further investigation.

ACC is also developing a new system to improve how claims are registered, assessed and approved. This system will use anonymised data from 12 million claims that were submitted between 2010 and 2016, and will identify characteristics of a claim that are relevant to whether a claim will be accepted. Simple claims – where the information provided shows that an injury was caused by an accident – will be fast-tracked and immediately accepted. Complex or sensitive claims will be reviewed by an ACC staff member, which is currently the process for all claims.

> ***"ACC uses algorithms based on claims data, built up over many years, to help understand and personalise clients' support needs.***

Research and policy development

Most of the participating agencies indicated that they employ algorithms to some extent in non-operational areas to use data to model potential interventions, forecast future demand, and evaluate effectiveness. This forms an important part of ensuring that the agency is achieving its aims, and implementing government policies.

Two major contributors to government research are the Integrated Data Infrastructure (IDI) and the Longitudinal Business Database (LBD), managed and maintained by Stats NZ. The IDI and the LBD are large research databases that hold de-identified data collected by government agencies and non-government organisations (NGOs) about people, households, and businesses on topics that include:

- people and communities
- education and training
- income and work
- benefits and social services
- population
- health
- justice
- housing
- innovation data
- business financial data
- agriculture data
- international trade
- business practice
- employment.

Approved researchers from inside and outside government use the IDI to gain insight into our society and economy. Research that draws on this large, linked data collection can help answer questions about complex issues that affect people in New Zealand. Data in the IDI is de-identified. This means information like names, dates of birth, and addresses has been removed. Numbers that can be used to identify people, like IRD and National Health Index (NHI) numbers, are encrypted (replaced with another number).

CASE STUDY

Population projections

Challenge: Many services, such as health, education, and transport, need to be designed and implemented with direct reference to the size and types of populations that they serve. It is therefore essential that organisations have some indication of likely changes in population patterns over time.

Solution: Stats NZ develops population projections to support agency planning. Population projections are derived from an assessment of historical, current, and likely future trends in births, deaths, and migration – the three components of population change. Assumptions about future fertility (births), mortality (deaths), and migration are formulated after analysis of short-term and long-term historical trends, government policy, information provided by local planners, and other relevant information. This approach involves creating 2,000 simulations for the base population, births, deaths, and net migration, and then combining these using the cohort component method.

Outcome: The projections provide an indication of the overall trend, rather than exact forecasts, and are used by government agencies, NGOs, and the private sector to support both short-term and long-term planning needs.

The Social Investment Agency uses data and evidence to inform how the social sector (Health; Education; Social Development; Justice; Business, Innovation and Employment) can best improve the lives of New Zealanders by investing in what's known to create the best results. Most of this research uses the IDI or freely available online sources, such as maps of New Zealand regions, and published official statistics.

An example includes the Social Housing Test Case which compared outcomes for people who applied for social housing and were approved and housed, with those who were not housed. Statistical techniques and algorithms were employed to enable a robust comparison between these groups. The subsequent research and algorithm code tools were published as a resource for future research.

The Social Investment Agency does not use algorithms that make operational decisions in place of a human decision-maker, or that narrow the scope of operational decisions available to human decision-makers.

“The Social Investment Agency uses data and evidence to inform how the social sector (Health; Education; Social Development; Justice; Business, Innovation and Employment) can best improve the lives of New Zealanders by investing in what's known to create the best results.

04
ASSURANCE AND SAFEGUARDS

It is standard practice for agencies to ensure that algorithms and related analytical tools are fit for purpose from a technical perspective, and that they meet relevant legal requirements such as those in the Privacy Act. However, consideration of the broader ethical implications of using these techniques is important to demonstrate that due care has been taken in relation to the impact on individuals.

Participating agencies that use algorithms to support operational decision-making all have a form of assurance around the algorithm's development. These include:

- the use of Privacy Impact Assessments
- human rights assessments
- ethical review
- peer review
- contracting external expertise.

The type and extent of the assurance process varies between agencies and responsibility for assurance is often delegated to a particular role within an organisation.

> ***This report makes a broad assessment against principles, drawing on the material submitted by 14 participating agencies.***

Another option for agencies is to establish or expand formal governance groups to oversee the use of data and algorithms. Such groups tend to oversee performance and updating of models to ensure they meet ethical and privacy standards, continue to achieve expected performance, and adapt to changing circumstances.

Although many agencies report that they are considering the establishment of governance groups, few have yet done so and only a small number have well established frameworks at this time.

Assessment against the principles for safe and effective use of data and analytics

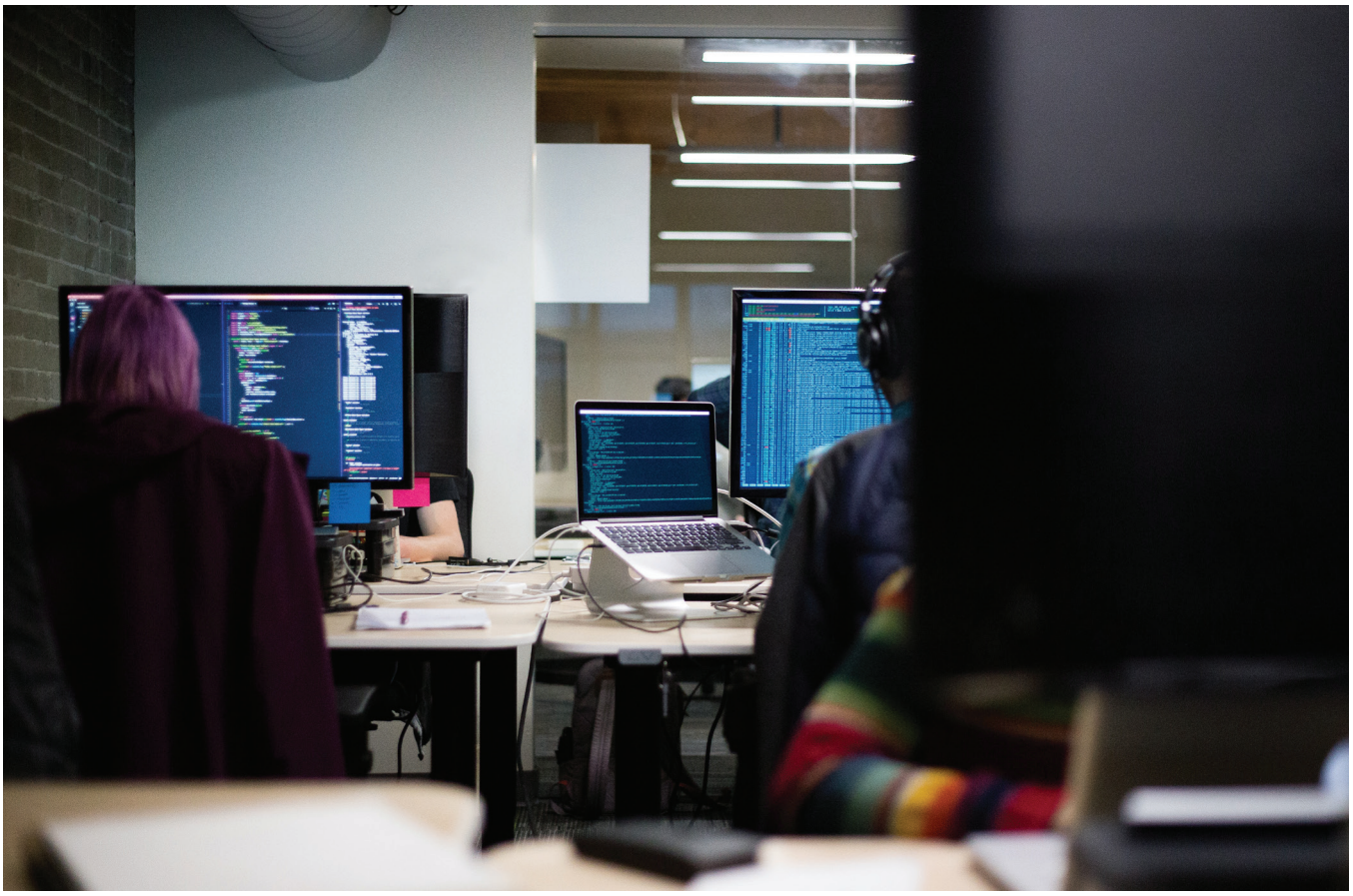
In May 2018 the Government Chief Data Steward and the Privacy Commissioner jointly published six principles for the safe and effective use of data and analytics.

The principles provide a useful starting point to help government agencies apply best practice to their use of algorithms and related analytical tools. In doing so, government agencies can help to ensure that people in New Zealand can have confidence in the way the Government uses information that can affect their lives.

This report makes a broad assessment against principles, drawing on the material submitted by 14 participating agencies.

PRINCIPLE
Deliver clear public benefit

It's essential that government agencies consider, and can demonstrate, positive public benefits from collecting and using public data. All of the algorithms described by agencies are embedded in policies that are intended to deliver some level of public benefit.



These include:

- improved efficiency, which reduces cost for the taxpayer (for example, operational algorithms used by Inland Revenue to administer the tax system)
- streamlining processes to reduce the burden on members of the public (for example, the algorithm that enables streamlined passport renewal used by the Department of Internal Affairs)
- proactively targeting specific support to an individual based on data (for example algorithms used by ACC to improve client outcomes)
- supporting decisions which may be taken under complex or challenging circumstances (for example, the victim history scorecard the Police use to understand the cumulative harm a victim is subjected to)
- protecting New Zealand from risks and threats while enabling growing volumes of travel and trade (for example Immigration New Zealand and Customs algorithms that screen and assess passengers and goods at the border)
- providing empirical assessment to support a decision that identifies individuals who would benefit most from a new intervention or policy (for example, the NEET algorithm used by the Ministry of Social Development which uses a statistical predictive modelling tool to help identify those school leavers who may be at greater risk of long-term unemployment)
- providing assessment or forecasting to ensure policies are targeted properly and resourced adequately (for example the Social Housing Test Case developed by the Social Investment Agency).

The algorithms support the core activities of each agency and these activities are based on well-established policy and legal frameworks.

It is less clear to what extent agencies have actively considered the views of stakeholders, particularly those that are the subjects of the algorithm-driven processes in question. None of the material supplied by participating agencies references this aspect in the development and implementation of algorithms, although it is possible that this may have occurred through a wider policy development process.

EXAMPLE OF GOOD PRACTICE

Data protection and use policy

Between May and August 2018, the Social Investment Agency conducted workshops and held meetings across New Zealand to find out what people and organisations thought about the Government's proposed approach to investing for social wellbeing and the protection and use of personal information in the social sector. Feedback from the engagement process will inform decisions by the Government on the way that data is protected and used in the social sector.

A summary of engagement can be found on the SIA website: https://www.sia.govt.nz/our-work/yoursay/latest-updates/

In summary, the development of algorithms by participating government agencies is well aligned to the delivery of clear public benefit in a range of circumstances. However, there are clear opportunities to ensure that the perspectives of stakeholders are a part of future algorithm development, including embedding a te ao Māori perspective through a Treaty-based partnership approach.

PRINCIPLE

Maintain transparency

Transparency is essential for accountability. It supports collaboration, partnership, and shared responsibility. Three-quarters of the participating agencies provide descriptions of their operational algorithms on their websites. These descriptions vary significantly and include:

- largely technical documents that may be difficult for anyone who is not familiar with data processing to understand
- plain English descriptions of the rationale and use of algorithms including examples
- infographics that display, at a glance, the way in which data is being used, and the possible outcomes for people.

In some cases, this information is relatively easy to locate by navigating from an agency's homepage. In others it is necessary to use a search function to locate the appropriate page. In both cases, but particularly the latter, information about data and algorithm use is not given prominence on agency webpages. It is apparent that the user required a reasonably precise idea of what they were looking for to locate it.

As government agencies deal with public information, and act in the service of the public, all agencies should strive to ensure that:

- data use and analytical processes are well documented, and
- the decisions they inform are described in clear, simple, easy-to-understand language.

This helps to ensure accountability and builds and maintains the public trust that is essential to the work of government. It is also a tool to support frontline staff who deal with the public on a regular basis and may need to explain the tools used to support their decision-making.

In summary, while some participating government agencies are describing algorithm use to a best practice standard, there is no consistency across government. There are significant opportunities for agencies in general to make improvements to descriptions about how algorithms inform or impact on decision-making, particularly in those cases where there is a degree of automatic decision-making or where algorithms support decisions that have a significant impact on individuals or groups.

PRINCIPLE

Understand the limitations

While data is a powerful tool, all analytical processes have inherent limitations in their ability to predict and describe outcomes.

Data bias poses a significant challenge for effective algorithm use. Even the best algorithms can perpetuate historic inequality if biases in data are not understood and accounted for.

Only a minority of participating agencies described a formal process for considering the limitations of algorithms as a part of the development process for these tools.

Few agencies reported any regular review process for existing algorithms to ensure they are achieving their intended aims without unintended or adverse effects. This suggests a risk that the limitations of algorithms, and the data they draw upon, may depend on the skills and experience of individuals in particular roles and, therefore, may not be systemically and consistently identified to decision-makers.

EXAMPLE OF GOOD PRACTICE

Privacy, Human Rights and Ethics Framework (PHRaE)

The Ministry of Social Development has developed the PHRaE framework to help identify the privacy, human rights, and ethical risks associated with the operational uses of personal data. The PHRaE process runs alongside any development of a proposed use of client data by the Ministry, and prompts the project owner to detail and discuss the way in which their project will use personal information. A formal review at the end of the process documents the PHRaE risks and describes how these are to be mitigated.

A major part of algorithm improvement is in reviewing and assessing outcomes and making subsequent improvements, to ensure there are no unfair, biased, or discriminatory outcomes. It appears from the responses from participating agencies that there is little consistency across government in formally undertaking this process at regular intervals.

In summary, while some participating government agencies have formal processes to review algorithms during development and in subsequent operation, most do not. There is no consistency across government to embed such processes within organisational policy, rather than rely on individual accountability. This suggests significant room for improvement, both to support decision-makers and to ensure the continuous improvement of algorithms.

PRINCIPLE

Retain human oversight

Analytical processes are a tool to inform human decision-making and should never entirely replace human oversight, although the extent of human oversight may depend on the significance of the decision and on other safeguards in place.

Almost all participating agencies use operational algorithms to inform human decision-making, rather than to automate significant decisions. Where decisions are automated, these usually relate to automatic approvals or opportunities for people. None of the participating agencies described a circumstance where a significant decision about an individual that was negative, or impacted entitlement, freedom or access to a service, was made automatically and without human oversight.

Most participating agencies indicated that they expect to develop operational algorithms that rely on Artificial Intelligence in the future. It will be challenging to clearly explain how these type of algorithms work and support decision-making, and how a given outcome was reached. As technology continues to evolve, this will continue to be an area where government agencies must balance the importance of human oversight with possible efficiencies in service delivery.

PRINCIPLE

Data is fit for purpose and a focus on people is retained

The work undertaken for this report is not a comprehensive assessment of the ways in which participating agencies collect, store, use, and protect the personal information of individuals. However, the information collected for this report regarding the use of algorithms indicates that there are pockets of excellence across government but that there are also opportunities for agencies to develop more formal and consistent procedures to improve their data governance.

05
CONCLUSION AND RECOMMENDATIONS

Across the government data system, algorithms have a key role in supporting agencies to undertake their work to improve the lives of people in New Zealand. The scale and scope of public interactions with government outlined in this paper show just how essential these tools have become to the efficient and smooth provision of services, and to delivering new, innovative, and well targeted policies to achieve government aims.

The recommendations outlined in the following section provide a range of options for Ministers and government agencies to consider in order to improve transparency and accountability in algorithm use. This will help shape the work of the Government Chief Data Steward and the Government Chief Digital Officer in their roles of driving innovation, ensuring good practice, and providing better services across the data system.

Algorithm use

This review has found that although the extent of algorithm use to support operational activities is widespread, it is not consistent across participating agencies. Many of those agencies who interact regularly with New Zealanders have integrated their use of algorithms to support operational activities (ACC, Customs, Inland Revenue and the Ministry of Social Development).

Other agencies with a primarily operational focus (the Department of Corrections and Police) use algorithms less extensively, supporting their frontline staff to make decisions in certain specific circumstances as opposed to informing the majority of interactions.

Oranga Tamariki does not currently deploy any operational algorithms for use in operational decision-making. The Oranga Tamariki system is a case management system informed by professional social work practice and input.

This suggests that there could be considerable benefits for agencies to draw on expertise across government in the future development of safe and effective operational algorithms to support their frontline staff, particularly for those agencies with a limited use of algorithms currently.

Automated decision-making

Ensuring that citizens can understand how decisions are made about them is important in maintaining public confidence in the delivery of services. Participating agencies automate many basic administrative processes, and in the case of significant or complex decisions, sometimes use operational algorithms to produce information to inform human decision-making.

Where automated processes exist, they are usually restricted to decisions in favour of an applicant or client except where there is a clear degree of legal transparency related to automatic decision-making. Humans review and decide on almost all significant decisions, including those that go against an applicant.

Human decision-making may not necessarily be superior to an automated process based on computer analytics. However, systems with “humans in the loop” currently represent a form of transparency and personal accountability that is more familiar to the public than automated processes.

The required human oversight may vary depending on the nature and impact of a specific algorithm. In some cases limited involvement may be appropriate.

However, where algorithms are material to decisions which affect people's lives in significant ways, it is reasonable to expect that a real person has exercised human judgement during the process and over the final decision.

Participating agencies described two instances where automated decisions are occurring, or may occur in the near future, that have a significant impact on individuals:

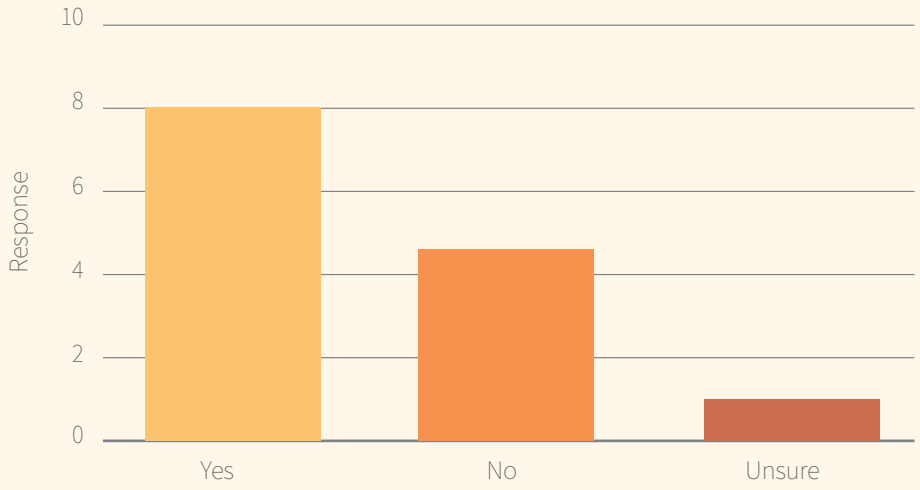
- Inland Revenue may automatically deduct funds from a person via their bank or employer to satisfy obligations like child support. Inland Revenue only takes this step after providing the person with an opportunity to resolve the obligation on their own terms. After the deduction the person is notified and provided with an opportunity to discuss or review the action.
- The Courts Matters Bill currently before Parliament allows for automated electronic systems to add fines to existing arrangements, and issue attachment orders or deduction notices, without the need for a Collections Registry Officer to make the decision. The bill requires that a safeguard process must be available for an affected customer to ask for review of a decision.

In both instances, the use of automatic decision-making is clearly established under law. Legislation gives permission for the agency to use automated electronic systems, but their use is not mandatory, and the legislative process provides for transparency and public scrutiny.

Human oversight cannot be taken for granted in the future. As technology, particularly Artificial Intelligence and machine learning, becomes more powerful and sophisticated, it will be increasingly important to retain human oversight of significant decisions. A majority of participating agencies identified that, in the future, they anticipate using algorithms that employ elements of Artificial Intelligence to inform more sophisticated and complex decision-making. Five agencies indicated they did not expect to develop AI-based algorithms, while one agency was uncertain about future development in this area.

This suggests that agencies will need to be aware of how they adapt to new technologies and deploy new algorithms in the future to ensure human oversight is retained at appropriate levels.

Do you expect to develop algorithms that rely on AI in the future?



RECOMMENDATIONS

1. Human oversight

Consideration should be given to ways in which agencies could develop formal policies regarding the balance between automated and human decision-making. Demonstrating accountability at an organisational level regarding decisions that affect people in New Zealand directly is key to maintaining public confidence in the work of government.

Development and procurement

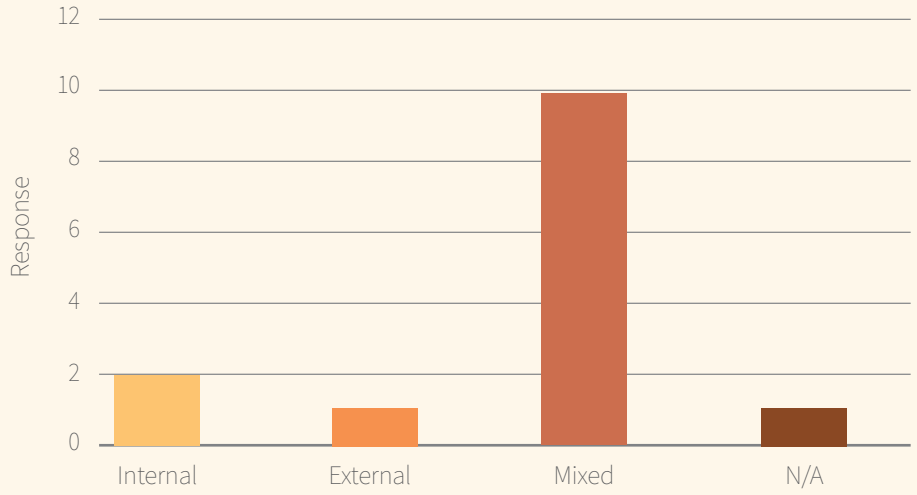
Algorithms are commissioned in different ways. Sometimes this occurs as the result of operationalising improvements identified via data modelling related to current processes, and sometimes an algorithm is commissioned in response to a specific identified need or policy objective.

In either case, it is important that the algorithm development be subject to a process to ensure that stakeholder views are considered, privacy and ethical considerations are explored, and any trade-offs or limitations are made clear to decision-makers, along with a clear understanding of the benefits to be delivered.

Participating agencies reported three main approaches to algorithm development, each with benefits and drawbacks:

- Internal development – this allows for greater control and scrutiny of intent but relies on having the necessary technical expertise within the agency. Some participating agencies have taken this approach.
- External procurement – this involves out-sourcing the development to a third-party provider. This is likely to allow a greater level of specialist expertise to be employed, but may also incur up-front costs and costly continued support. This approach was infrequently used by participating agencies and, where it was, bespoke products rather than off-the-shelf solutions were required. In this approach there is often significant training or knowledge development required for the agency concerned.
- A mixed model – in this approach external expertise is contracted into an internal development process. If properly managed this can deliver the benefits of both previous approaches, but necessitates adaptability to ensure that the agency can effectively maintain, review, and administer the algorithm once contracted staff have left. This is the most common approach of participating agencies.

Who designed or created the algorithm



Most agencies (10 of the 14) use a mixed model, drawing on expertise across the agency and external providers, to develop their algorithms. The remaining agencies use internal expertise (2), external expertise (1), or do not use operational algorithms.

The Government currently provides detailed guidance on procurement[8]. However, the unique challenges of algorithms – understanding the limitations of the underlying data and recognising and adapting to any subsequent bias – suggest that there may be some benefit in producing additional guidance specific to algorithm development. Consideration also needs to be given to the procurement of algorithms through third-party or cloud-based technologies, in particular, the extent to which external companies can withhold information on algorithm content or functionality to protect commercial interests.

Government agencies already recognise and reflect the importance of transparency in the development phase of work in other domains. For example, Regulatory Impact Assessments are routinely completed and published by agencies. These consider practical options for addressing a policy problem through regulation, set out the benefits of the preferred option, and explain why other options have not been chosen.

Agencies also complete Privacy Impact Assessments to identify the potential risks arising from their collection, use or handling of personal information, to determine whether they are meeting their legal obligations.

A similar process could be employed by agencies who wish to employ algorithms to solve a policy problem or deliver a new service. This could focus on a best-practice approach, incorporating the principles for the safe and effective use of data and analytics, in addition to addressing legal obligations and considering other possible solutions.

This review has also found that there is no consistent approach to capturing and considering the views of key stakeholders during the algorithm development process. While it is not going to be practical or expedient to directly consult with all stakeholders on the development of every algorithm, it is important to ensure that the perspectives of those who are impacted by algorithmic decision-making have been considered, particularly when new algorithms are part of a new service or a substantial change in delivery approach.

Therefore, it is recommended that agencies formalise and document stakeholder perspectives as they would when developing a significant policy or legislative change. Particular consideration should also be given to embedding a te ao Māori perspective through a Treaty-based partnership approach. This includes reflecting the taonga status of data that relates to Māori.

8 https://www.procurement.govt.nz/procurement/

RECOMMENDATIONS

2. Development and procurement

2.1 Consideration should be given to ways in which agencies could implement processes to capture and consider the views of their key stakeholders during the algorithm development process, notably the people who will be the subjects of the services in which algorithms will be embedded. Consideration should also be given to ways to embed a te ao Māori perspective as appropriate, through a Treaty-based partnership approach.

2.2 Consideration should be given to ways to implement processes across agencies to ensure that privacy, ethics, and human rights considerations are considered as apart of algorithm development and procurement.

Information and transparency

This review has found that while some participating government agencies are describing algorithm use to a best practice standard, using clear plain English descriptions or infographics, there is no consistency across government. While information is usually provided on websites, it can be difficult to find and is often highly technical.

Transparency is essential for accountability and to maintain public confidence and trust in the way that data is collected, stored, and managed on behalf of people in New Zealand. There are significant opportunities for improvement.

There are some instances where transparency must be moderated against other public good considerations, for example in the instance of algorithms that relate to security or justice. In these cases it may be more appropriate to describe how the algorithm has influenced decision-makers rather than detailing the algorithm itself.

RECOMMENDATIONS

3. Information and transparency

3.1 There is scope for agencies to review the information that they publish to ensure that they clearly explain how significant decisions are informed by algorithms.

3.2 As well as publishing simple summaries, consideration should also be given to the publication, on an agency by agency basis and within a common framework, of more detailed information about how data is collected and stored, the computer code used in algorithms, and what role the algorithm plays in the decision-making process for those who are interested in more technical material.

3.3 Examples of best practice should be shared across agencies to inform a review of current processes.

Review and safeguard

This review has found that all participating agencies have some form of assurance process around their development and/or procurement of algorithms. However, subsequent, ongoing monitoring and review of algorithm use was not reported as strongly by agencies.

Half of the participating agencies said they would consider establishing or expanding governance groups to oversee future development and use of models, but few have done so already. Such groups tend to oversee performance and update of models to ensure the models meet ethical and privacy standards, continue to achieve expected performance, and adapt to changing circumstances.

Although there are positive steps being taken to ensure robust development of algorithms there is opportunity to strengthen the focus on ongoing monitoring and assurance to ensure algorithms are achieving their intended aims or have not had adverse effects.

RECOMMENDATIONS

4. Review and safeguard

There are opportunities for agencies to implement formal processes to regularly review algorithms that inform significant decisions. This would help to ensure that these tools are achieving their intended aims and that they have not created unintended or adverse effects.

Sharing best practice

This review has found that, across a range of areas relating to algorithm development and operation, there are examples of good practice in participating agencies but also room for improvement. Sharing best practice between agencies is an obvious first step in raising the transparency and accountability of government algorithms.

Almost all the participating agencies agree that additional cross-government guidance on the creation and use of algorithms would be helpful, and that it would be useful to be able to seek external, independent, expertise on algorithm creation, use, and ongoing monitoring and review.

RECOMMENDATIONS

5. Sharing best practice

5.1 Consideration should be given to establishing clear mechanisms by which agencies could share best practice in the development of algorithms, the way the decisions they inform are described to the public, and the ongoing safeguards that are built into their operation.

5.2 This could include establishing a centre of excellence to provide support and advice on best practice processes across government.

5.3 In addition, there is merit in developing additional mechanisms to assist agencies to seek advice from privacy, ethics, and data experts outside government.

Further assessment

The first phase of this review has focused on operational algorithms used by 14 agencies that result in, or materially inform, decisions that impact significantly on individuals or groups. Participating agencies have been primarily social sector agencies with significant data and analytics capability.

While this is an important first step in mapping and describing the way that the Government is using algorithms, the review has been necessarily limited in terms of scope. Subsequent phases could include:

- reviewing the algorithm use by wider government, potentially including crown entities and other government funded organisations
- assessing algorithms used in other aspects of decision-making in more detail, such as policy development and research
- undertaking a more detailed review of current algorithms.

Expanding this assessment into a second phase with a greater scope will require additional resources to ensure that the work can be completed in a timely fashion, utilising appropriate skills and expertise. Weighing the potential benefits and costs of a further assessment phase will be a future decision for the Government.

Sharing best practice between agencies is an obvious first step in raising the transparency and accountability of government algorithms.

06

Appendix: Operational algorithms described by participating agencies

Agency	Algorithm title	Description
Accident Compensation Corporation	Automated claims approval model	Automatically approves simple claims, identifies the level of support that claims will need, and streams them to the most appropriate claims management approach.
	Conversion probability	This tool calculates the likelihood that a given claim will require weekly compensation.
	Expected Claims Outcome (ECO)	This is used to rapidly identify clients who are likely to need assistance over and above paying for treatment.
	Rehab Tracking Tool (RTT)	Used to identify those that require additional assistance, eg because their recovery is off track.
	Financial Impact of Decision (FID)	FID assists case owners in determining the type of assistance that will achieve the best outcomes for clients with high needs.
	Smart supports tool	ACC intends to add a tool to its client self-service portal which will provide tailored support recommendations directly to customers.
	Fraud, waste, and abuse	A series of pilot projects focused on identifying areas of potential fraud, waste, and abuse.
Department of Corrections	Risk of Reconviction / Risk of Re-imprisonment "RoC*RoI".	Scores on this measure express the probability that an individual offender will be reconvicted and re-imprisoned for new offending within the following five-year period.
Department of Internal Affairs	Passport applications	This algorithm supports automatic processing of passports through undertaking over 140 checks of a passport application against previous passport data and the identity referee's passport.
	Passports facial recognition	To establish the identity of an applicant all passport photos undergo automated facial recognition testing. Photographs submitted with applications are compared to photos held in the passports database.
	Passports risk algorithm	All passport applications are automatically assessed against identified risk factors. Applications that meet the risk threshold are referred to passport staff and processed manually.
	Birth registration reminder letters	A matching programme attempts to match preliminary notices of birth information with formal birth registration to prevent reminder letters being sent out.
	Citizenship by birth	Algorithm used to determine the citizenship by birth status of a child born in NZ. Parent identity records are matched to the child. If a match is not made automatically, it is passed on for manual intervention.
	Death registration	When a death is registered an attempt is made to match it to a NZ birth record.

Inland Revenue	Automatic refunds operational algorithm	Current year (tax submissions) is compared to previous year (reported). Where there is reasonable certainty on the income reported and the customer is tax positive then an automatic refund will be given.
	Good comparator tool	Used to estimate levels of tax suppression of companies.
Ministry of Business, Innovation and Employment (including Immigration New Zealand)	IDMe (Identity Management system of INZ)	Identity matching and resolution decides if a customer is someone for whom INZ already has an identity created and stored in its system. The matching uses biographic and/or biometric information.
	Visa application risk triage	Assigns a risk level to visa applicants based on risk rules that use information INZ holds about the applicant. The risk level only determines level of verification required, it has no relationship with decision-making.
	Advance Passenger Processing (APP)	The algorithm performs some validation matching, as well as some automated "border checks" (eg does the individual have a valid visa, if one is needed, or matching the individual's passport against a list of lost or stolen passports).
	Passenger Name Records (PNR)	The programme uses APP information and Passenger Name Records data to assess potential risk associated with travellers who don't require a visa.
Ministry of Education	School Transport Route Optimiser (STRO)	The School Transport Route Optimiser calculates student eligibility for transport assistance and develops the most efficient routes for school buses.
Ministry of Health	InterRAI	InterRAI assessment instruments are used to assess the physical and social support needs of (primarily in New Zealand) older people. The items in each assessment instrument are recorded in a standardised way that translate into data elements.
	CPAC – elective surgery prioritisation	Clinical Prioritisation Access Criteria are a suite of tools that are designed to rank individual patients based on clinically developed criteria (and categories) with appropriately weighted points attached.
Ministry of Justice	Segmentation	Segmentation is based on customers' past events such as their fines history and previous breaches of arrangements. The use of segmentation helps to move away from a one-size-fits-all approach to resolving fines, by tailoring more appropriate interventions to different customer segments.
	Work manager	The 'work manager' is a series of systems that capture, prioritise, and distribute work for Collections Registry Officers to action. Work tasks are prioritised using a points system based on information about the case such as the type and value of penalty, availability of information about a customer (eg address or employer), and Ministry priorities (eg reparation would be prioritised above other collections activity).
	Attachment orders	An attachment order instructs an employer or Work and Income to transfer money from the debtor's wages or social benefit to the Ministry. A list of cases eligible for attachment orders is automatically generated each day based on eligibility criteria using case information and customer history, and this process has been active since 2016.

Ministry of Social Development	Client Service Matching (CSM)	A set of rules is used to determine the best case management service for each client. Different services are designed to serve specific groups of clients in the best way possible, so the rules help us provide the right service to the right client. Each client's situation is considered, including factors such as: • their age • the length of time they have been on a benefit • any part-time or full-time work obligations • any health condition or disability • the status of any children in care.
	Youth Service for young people Not in Education, Employment or Training (NEET)	Established in 2012, the service uses a statistical predictive modelling tool to help identify those school leavers who may be at greater risk of long-term unemployment. The model looks at what we know about a young person, how old they are and where they live, as well as whether their parents are on a benefit, if they've ever been involved with Oranga Tamariki, and their school histories.
New Zealand Customs Service	Targeting profile	Information about incidents of non-compliance are used to identify risk and target resources. These targeting rules and profiles separate out packages and other border transactions that have characteristics, shown by the available data fields, which match the known risk criteria.
	Customs' business improvement	This work has included the development of customer segmentation models, incorporating algorithms, for excise, trade and travellers which seek to group Customs' customer base by what they need, their behaviours, and compliance intent.
New Zealand Police	Youth Offending Risk Screening Tool (YORST)	YORST is a risk screening/assessment instrument. This algorithm is based on a questionnaire, including questions about education, living situation, parent offending history, and past recorded events such as time since last incident, time since last offence, total number of previous offences.
	Family violence risk assessment tools	**Static risk (SAFVR)** This algorithm calculates the probability that a family violence perpetrator will commit a crime against a person (in the context of family violence) within the next two years given the officer is at a family harm investigation at the time the SAFVR measure is considered (the algorithm shows the aggressor as low, medium, or high risk). This algorithm is based on data held in Police systems and includes characteristics of the offender such as gender, past incidents of family harm or criminal history, and characteristics of current offending. **Dynamic risk measure** This is an algorithm that uses the responses to a series of questions at initial scene attendance to determine a dynamic risk level. These questions are based on research from New Zealand and overseas and are strong indicators that violence is escalating or likely to occur again. The static measure is combined with the dynamic risk level to create an overall level of concern for safety for the people involved.
	Victim History Scorecard (VHS)	VHS is a victim support tool developed by Police. The purpose of the VHS is to flag to officers serious or repeat victimisation within a rolling 12 month period to assist in an understanding of the cumulative harm a victim is subjected to. The VHS reflects the typical value judgement of police officers about the level of victimisation risk a victim has, and classifies victims as having high, medium or low victimisation risk. It also informs choices about the appropriate response and support for victims and also for ongoing support for victims who are exposed to chronic or cumulative harm over a rolling 12 month period.
Oranga Tamariki	Nil	N/A


New Zealand Government