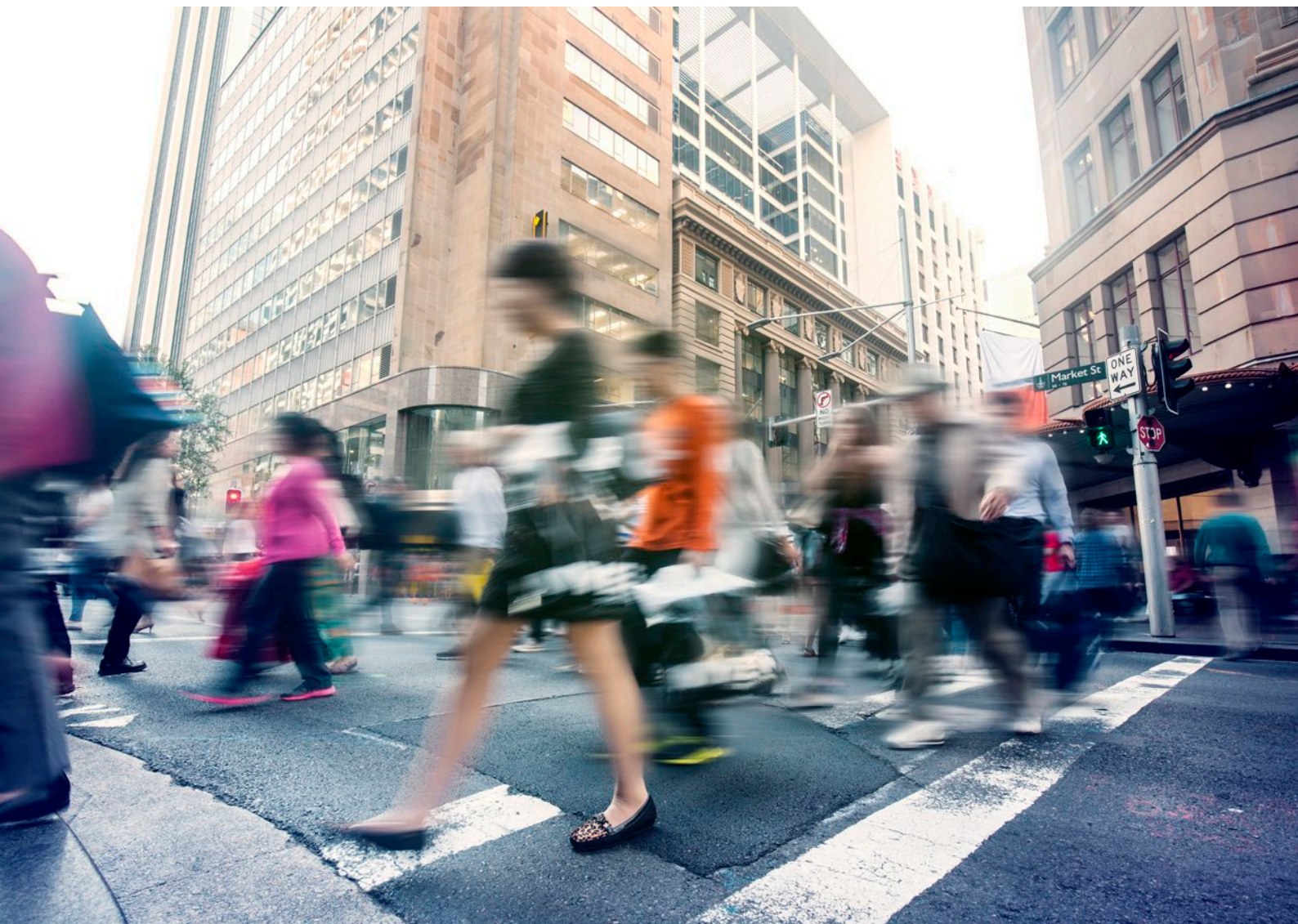




Australia's National  
Science Agency

# Responsible Innovation: What do Australians think?

Results from the 2021 Responsible Innovation  
National Baseline Survey



## **Citation**

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# Responsible innovation in Australia

Responsible innovation is the idea that scientific innovation and new technology development can be directed towards achieving outcomes that deliver broad societal benefit. Responsible innovation is even more critical when we think about new and emerging areas of future science and technology which are likely to have far reaching impacts on the world around us. This report explores the perceptions of Australians about responsible innovation and what role responsible innovation has in ensuring future science and technology is delivering positive outcomes to all Australians.

## The world around us is changing, and so is science and technology

In 2022, increasing environmental, social and economic pressures are demanding fast-tracked solutions from science and technology. For example, the global COVID-19 pandemic saw an acceleration of biotechnology-driven solutions to develop, manufacture and deploy safe and effective vaccines. Climate change and the trajectory of global emissions is demanding novel environmental interventions with solutions such as negative emissions technologies being proposed to remove greenhouse gases from the atmosphere. With a changing climate and growing population, increasing demand on resources is also driving transformation in agri-food systems and new and disruptive food innovations, such as alternative protein sources.

We have long relied on science and technology to help us understand and navigate the world. However, with increasing need to address multiple and complex challenges, we are also demanding more innovative solutions from science and technology to respond to crises. This means fast-tracking the development of emerging areas of future science and technology that are more prospective and novel.

Examples of future science and technology from within CSIRO's own research portfolio include new and cross cutting sciences such as synthetic biology and artificial intelligence (AI), and the development of novel technologies that will transform many industries.<sup>1</sup> This includes the potential use of genetic technologies to manage invasive pest species or address environmental pollution,<sup>2</sup> the use of AI and robotics in healthcare to improve patient outcomes along with personalised healthcare interventions,<sup>3</sup> and new ways of generating and storing energy for a range of household and industry uses.<sup>4</sup>

Advances in future science and technology have a key role to play in Australia's national security and economic prosperity and are expected to revolutionise the lives of everyday Australians.<sup>5</sup> However, the novelty of these innovations means their risks and benefits to society are not well understood. This is where responsible innovation can play a role.

Responsible innovation is an approach to assessing the potential risks, benefits and uncertainties associated with future science and technology with a view to ensuring socially responsible science and technology is designed and delivered for the benefit of all Australians.<sup>6</sup> But how do we know if the public is on board?

1 For more information about CSIRO's Future Science Platforms, see <https://www.csiro.au/en/about/strategy/Future-Science-Platforms>

2 Mankad, A., Hobman, E. V., Carter, L. & Collins, K. 2022 Public perspectives towards using genetic engineering for managing land and water pollution in Australia. CSIRO, Australia.

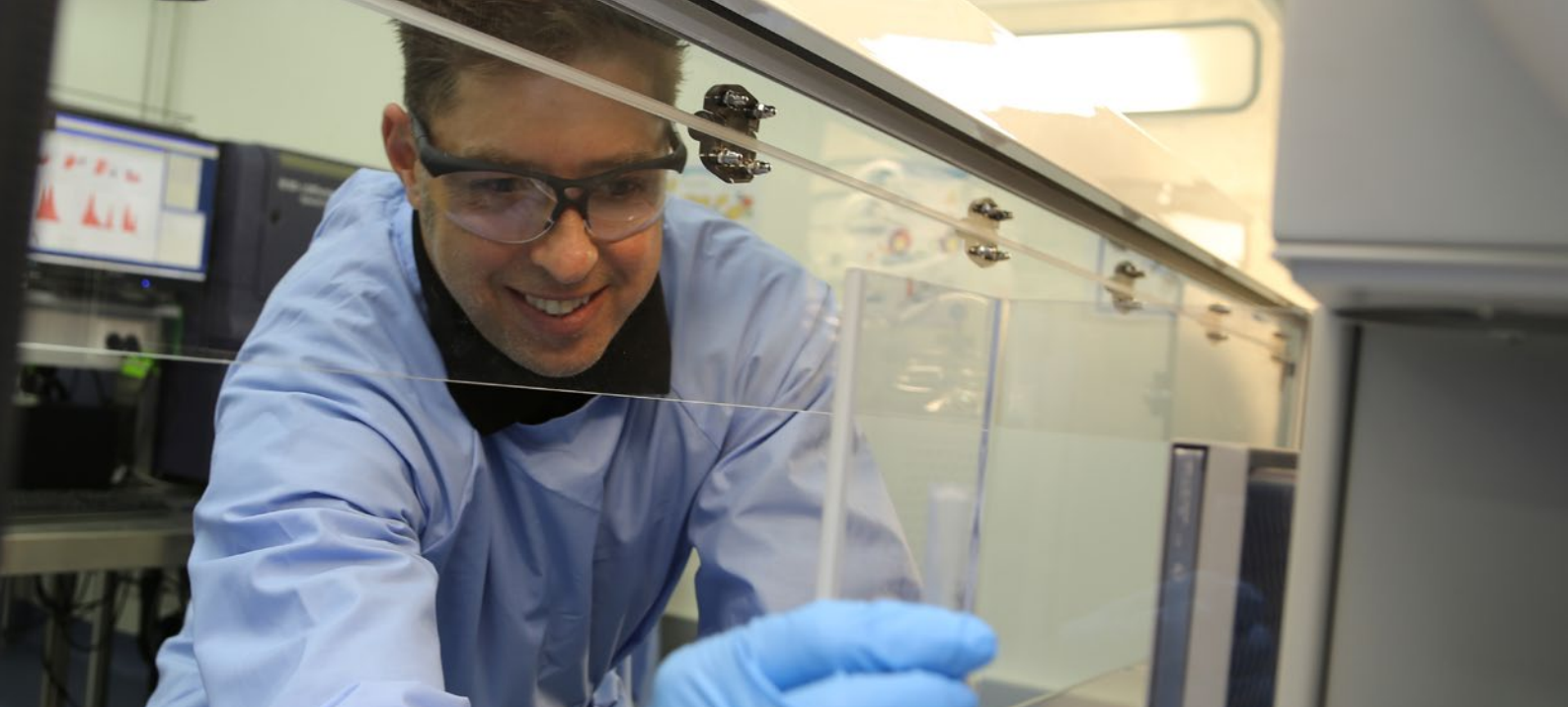
3 Douglas, D., Lacey, J., Howard, D. 2022. Ethical Responsibility and Computational Design: Bespoke Surgical Tools as an Instructive Case Study. *Ethics & Information Technology* 24, <https://doi.org/10.1007/s10676-022-09641-2>

4 Scovell, M. D. 2022. Explaining hydrogen energy technology acceptance: A critical review. *International Journal of Hydrogen Energy*, 47(19), 10441-10459

5 Commonwealth of Australia. 2021. *Blueprint for Critical Technologies: The Australian Government's framework for capitalising on critical technologies to drive a technologically-advanced, future-ready nation.* Department of Prime Minister & Cabinet, Canberra.

6 Herington, M., Coates, R., Lacey, J. 2019. *The science-society relationship in Australia: toward responsible innovation. Survey of Scientists, Researchers and Other Professionals in the Australian Research and Innovation System.* CSIRO, Australia.





## Understanding the role of responsible innovation

Responsible innovation is a research field that has been growing over the past decade. It asks us to look at the intent, principles, and practices associated with developing new innovations in science and technology and to think carefully about the kind of impacts such innovations may have on society and the broader environment, both now and into the future.<sup>7</sup> While responsible innovation scholarship has a longer history in Europe and the United States, it has been an emerging focus within the Australian research and innovation sector over the last five years.<sup>8</sup>

As we are still developing and refining our approaches to responding to the potential social and ethical risks across a diverse range of science and technology, we also need to scrutinise how these approaches are perceived by the general public. Two key questions are: 1) whether these approaches build public trust in Australia's research and innovation sector, and 2) and whether the public expect them to generate socially responsible outcomes that benefit Australians?

At CSIRO, we are committed to making the benefits of future science and technology available to all Australians, and through our Responsible Innovation Future Science Platform, we approach responsible innovation in two ways.

First, by supporting the design, development and adoption of responsible science and technology among relevant stakeholders and end users. Second, by engaging with communities to consider problems facing society, and to assess the benefits and challenges that potentially disruptive science and technology innovations might pose to their lives. The engagement and support of the Australian public is increasingly critical to developing future science and technology agendas that are responsive to broad societal aspirations and values.

Given CSIRO's commitment, the research presented in this report has two aims. The first is to develop, test and establish reliable measures of public perceptions of responsible innovation that will support benchmarking and ongoing assessments for how responsible innovation is perceived across the Australian population, including how the outcomes of responsible innovation are perceived. The second is to find out from Australians what they most care about when it comes to the development of potentially disruptive future science and technology.

In this report, we summarise the findings of a survey designed to address these aims. This survey forms part of a larger CSIRO program of research on responsible innovation<sup>9</sup>, which is examining how we can more systematically identify, understand and manage the social and ethical risks posed by a diverse range of future science and technologies.

7 Owen, R., Stilgoe, J., Macnaghten, P., Gorman, M., Fisher, E., Guston, D. 2013. A framework for responsible innovation. In R. Owen, J. Bessant, & M. Heintz (Eds.), *Responsible Innovation*. John Wiley & Sons.

8 Lacey, J., Fisher, E. 2020. Interview on responsible innovation and future science in Australia. *OMICs: A Journal of Integrative Biology*, <https://doi.org/10.1089/omi.2020.0044>. See also CSIRO's Responsible Innovation Future Science Platform at <https://research.csiro.au/ri/>

9 See CSIRO's Responsible Innovation research program at <https://research.csiro.au/ri/>

# About the survey

We designed a new survey to gather views from the Australian public about their perceptions of responsible innovation concerning new and emerging science and technology.

This survey was completed online by a representative sample of 4,080 people from the general public over a four-week period in July 2021.

To help participants understand what responsible innovation means, we provided the following short description at the beginning of the survey:

Responsible innovation is about relationships between people in society and emerging science and technology. It is about creating new futures in a socially responsible way. This includes:

- the relationship between science and society,
- how research institutions go about developing new technologies, and
- trust in research institutions, emerging technologies, and their possible uptake in society.

Participants were then presented with a 90 second [video](#), which was adapted from a pre-existing animation developed by CSIRO's Responsible Innovation Future Science

Platform. The adapted version removed reference to CSIRO and provided a generic description of responsible innovation in relation to future science and technology.

## Why measure what the public think?

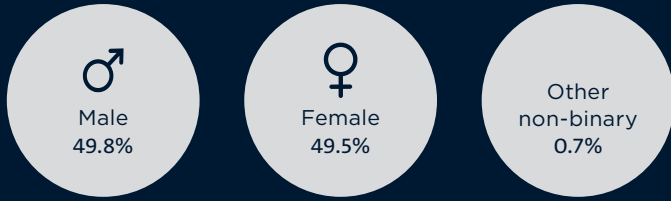
At a fundamental level, it is important that the Australian public can trust and have confidence in the work conducted by our research institutions and universities. This is especially the case when it comes to conducting frontier and potentially disruptive science and technology research to address complex problems facing society.

To understand what Australians think about responsible innovation, we asked survey participants to share their thoughts about different factors that may contribute to responsible innovation, their trust in the research and innovation sector<sup>10</sup> and what socially responsible outcomes they anticipate with future science and technology. This helps us to understand how the Australian research and innovation sector achieves socially responsible outcomes, in the eyes of the public.



# Survey participants: A snapshot of demographics

## Gender



## Age

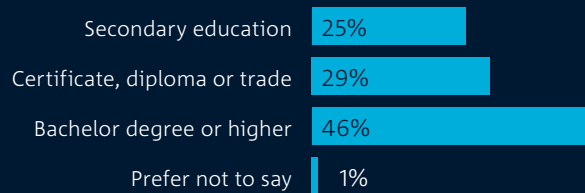


## Education



46%

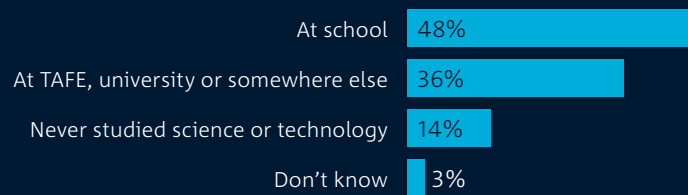
have a Bachelor degree or higher



## Studied science

48%

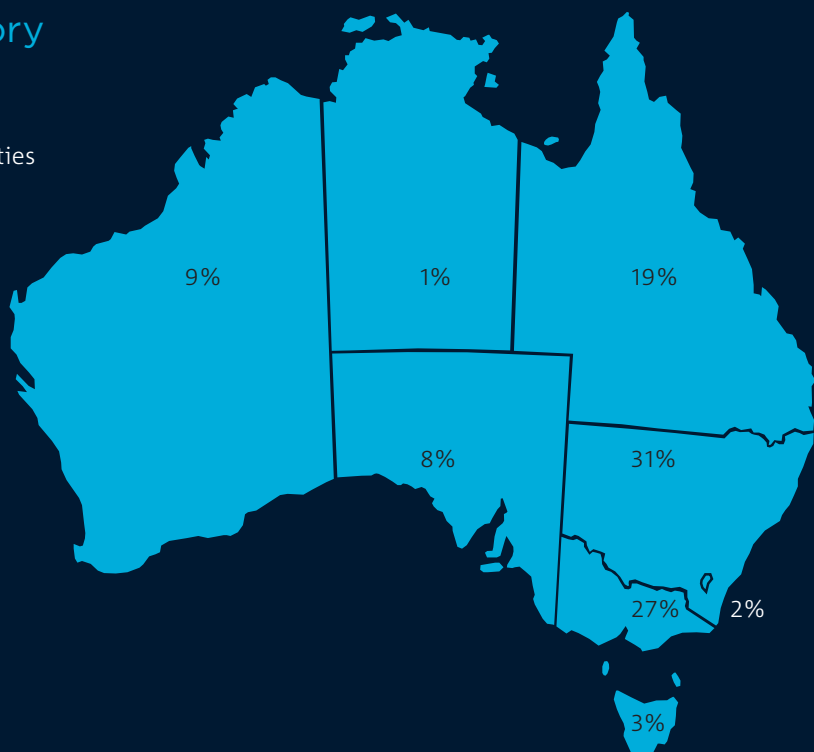
have studied science at school



## State or territory

4,080 participants

69% living in capital cities



# Measuring responsible innovation

To measure public perceptions of responsible innovation, we first needed to identify the elements of research and development that contribute to successful responsible innovation. This also included identifying what might contribute to building public trust in the research and innovation sector.

## Measuring responsible innovation

Responsible innovation has been written about extensively by researchers from around the world, but to date no one has tried to empirically measure or model the way responsible innovation works. By drawing on existing research and our own social science studies with the Australian public, we were able to identify a series of common elements that are often associated with socially responsible innovation, along with other factors that contribute to building trust in scientists and organisations in the research and innovation sector. These elements comprised:

- The practices of scientists, researchers and others involved in developing future science and technology in being responsive to society
- The role of research ethics in guiding future science and technology
- The risk management effectiveness of organisations developing future science and technology
- Confidence in governance arrangements of future science and technology.

To measure these perceptions, we asked participants to rate their level of agreement with a range of statements about responsible innovation. Agreement was measured using a scale from 1 (strongly disagree) to 7 (strongly agree), where 4 was neither agree or disagree. But first, we needed to develop the questions that would help us measure public perceptions of responsible innovation, broadly outlined below.

## Four elements of responsible innovation

### Science practices supporting responsiveness to society

Early scholars describe responsible innovation as being comprised of a series of practices on four 'dimensions'. In our survey, these four dimensions were used to assess public perceptions of the practices of scientists and researchers involved in developing future science and technology that support responsiveness to the broader priorities and concerns of society.<sup>11</sup> The four dimensions are:

- *Anticipation*: describes how much scientists anticipate and plan to manage the potential impacts of future science and technology. In this survey, our measures examined how much the public believes scientists carefully consider the long-term real-world impacts of their work and innovations on current and future generations, along with how different groups in society might be affected.
- *Inclusiveness*: describes how effectively different perspectives and forms of knowledge are considered and included in the development of future science and technology. Our measures asked the public how much they believe scientists genuinely engage with a broad range of stakeholders including end users, society at large, and people directly affected by the technologies/innovations.

<sup>10</sup> That is, universities, private companies, non-government organisations (NGOs), government agencies, and the CSIRO.

<sup>11</sup> Owen, R., Stilgoe, J., Macnaghten, P., Gorman, M., Fisher, E., Guston, D. 2013. A framework for responsible innovation. In R. Owen, J. Bessant, & M. Heintz (Eds.), *Responsible Innovation*. John Wiley & Sons.





- *Reflection*: describes the process of reflecting on broader societal issues when developing future science and technology, as well as scientists reflecting on their own assumptions and potential biases. Our measures examined how much the public believes scientists engage in this reflective process.
- *Responsiveness*: draws together the input of careful planning, inclusion of different perspectives, and reflection on social risks to guide decisions about the development of future science and technology. That is, how much does the public believe scientists are open to changing their innovations in response to feedback from a broad range of stakeholders, and wider society, as well as from unexpected scientific findings and their wider scientific community.

Figure 1 shows how we see these four science practices working together to support responsiveness to society. Reflection is a central dimension, grounded in inclusiveness and anticipating impacts from new and novel technologies. These three practices support responsiveness. That is, being open to changing how technologies are developed in response to broader considerations about the science and its impacts on society.

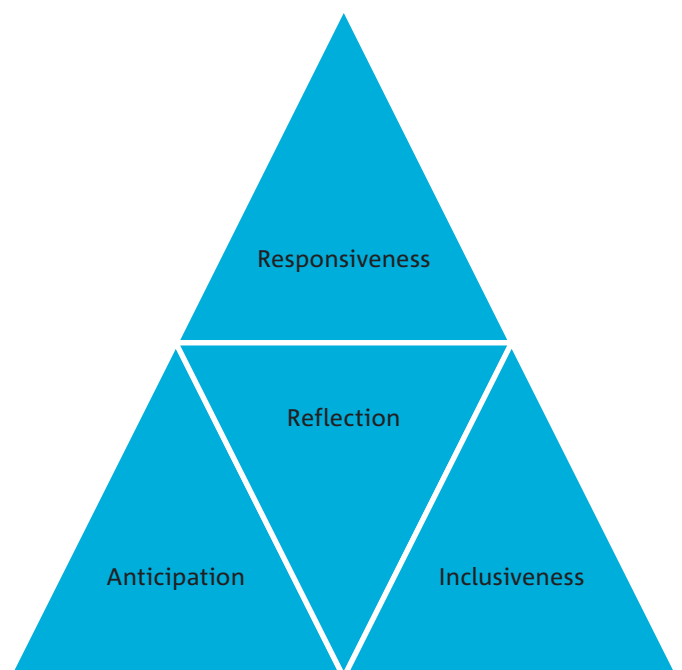


Figure 1 Science practices supporting responsiveness to society

## Research ethics

Research ethics, the responsible conduct of research and research integrity has also been identified as important to responsible innovation, and a matter of public concern.<sup>12</sup> The types of measures we developed to assess the role of research ethics examined whether the public believed that existing ethical principles and guidelines are sufficient for ensuring responsible innovation, whether ethical breaches are adequately addressed, and if the public is confident that researchers adhere to ethical guidelines in the conduct of their research.

## Risk management of future science and technology

Risk management refers to the mitigation and management of potential risks. In the survey, we asked participants how effective they thought research institutions were at managing potential risks associated with their research activities. This included assessing their ability to identify any adverse outcomes early, to manage risks appropriately, and have contingency plans in place, where appropriate.

## Confidence in governance of future science and technology

Another factor important to the public's level of trust in and acceptance of different activities is how confident they are in the governance and regulatory arrangements surrounding that activity. These arrangements refer to frameworks of authority and accountability that exist beyond those implemented by research organisations themselves. That is, the existence of and compliance with regulation and legislation. We explored this in relation to the governance of future science and technology in Australia.

## What kinds of outcomes can we expect from responsible innovation?

The purpose of measuring perceptions of the above four elements of responsible innovation is to test how much these elements contribute to expectations about responsible innovation being effectively and successfully delivered. The two outcomes we associate with successful responsible innovation are:

- The public's level of trust in the research and innovation sector to develop future science and technology
- The public's perception of socially responsible outcomes arising from future science and technology.

In this survey, trust in the research and innovation sector is comprised of public trust in both individual scientists and researchers, and the research institutions they work for. The measures of socially responsible outcomes explore a range of potential ways future science and technology might contribute to broader societal benefit (e.g. by being safe, in the public interest, and truly needed by society).

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<sup>12</sup> Resnisk, D.B., Shamo, A.E. 2017. Fostering Research Integrity. *Accountability in Research* 24, 367-372.

# Public perceptions of responsible innovation

In this section, we explore public perceptions of responsible innovation conducted by research organisations in Australia. This data provides a baseline of how well the Australian research and innovation sector is perceived to be practising responsible innovation in the eyes of the public.

Our survey results indicate that the Australian public have modestly favourable perceptions of responsible innovation on average.<sup>13</sup> Figure 2 shows the average or mean results for all elements of responsible innovation tested in this survey (i.e. the science practices supporting responsiveness to society are listed as four individual measures first, followed by research ethics, risk management, and confidence in governance arrangements). While the mean scores were all above the scale mid-point, there is always room for improvement in public perceptions.

The key findings about how the public perceives each element of responsible innovation are summarised below, each of which included a range of survey items.



Figure 2 Public perceptions of responsible innovation (means)

## Science practices supporting responsiveness to society

### Anticipation

Anticipation was the most favourably reported practice of responsible innovation with the highest mean score of 5.1. More than half of participants believed that scientists carefully consider the impacts of their future science and technologies. For example:

- 70.3 per cent of participants agreed that scientists carefully consider how the benefits weigh up against the potential risks or negative impacts
- 62.9 per cent agreed that scientists carefully consider how the technologies or innovations may be misused or used in alternative ways to that intended

### Inclusiveness

Perceptions of how effectively scientists include the perspectives of others in developing future science and technology were more modest, though still slightly favourable on average with a mean score 4.5 out of 7. Over half of participants believed that scientists genuinely engaged with a cross-section of society. For example:

- 59.2 per cent agreed that scientists genuinely engage with a broad range of stakeholders
- 59.5 per cent agreed that scientists genuinely engage with people directly affected by the technologies/innovations

<sup>13</sup> As mentioned, 1-3 represents unfavourable responses, 4 is neutral, and 5-7 favourable responses on average.

## Reflexivity

Australians generally thought that scientists were reflective about their research, how they went about it, the views of others, and implications for society (mean=4.8). This included reflecting on who may be socially responsible partners to collaborate with. When thinking about scientists developing future science and technology:

- 63.6 per cent believed that scientists reflect on who they can collaborate with to most benefit society
- 65.1 per cent believed that scientists take the time and space to reflect on the directions their research may be taking future society

## Responsiveness

The survey results also indicated that participants thought that scientists were generally responsive to feedback and new findings of relevance to their research (mean=4.8). For example, when thinking about scientists developing future science and technology:

- 67.0 per cent believed scientists were open to changing research directions in response to unexpected scientific findings
- 55.2 per cent believed that scientists were open to changing their innovations in response to feedback from broader society

## Research ethics

Participants generally perceived scientists as observing research ethics and adhering to research ethics procedures (mean=4.7). A little over half of participants thought that existing ethical principles and procedures for scientists were sufficient to ensure responsible innovation. Interestingly, when it came to addressing ethical breaches, a little under half believed that this occurred. For example:

- 56.6 per cent believed that current institutional arrangements (e.g. regulations and codes of conduct, organisational practices, and ethics committees) adequately support the ethical practice of scientists
- However, only 45.0 per cent believed that all ethical breaches were addressed

## Risk management

The survey results suggested that research institutions were generally viewed as being able to manage any potential risks associated with future science and technology research (mean=4.6), especially in terms of following through on any contingency plans. For example, in thinking about how risks are managed by Australian research institutions:

- 56.3 per cent of participants believed potential risks would be managed appropriately by those institutions
- 60.3 per cent believed contingency plans would be followed, while 50.5 per cent believed that any adverse outcomes of the research would be identified early

## Confidence in governance arrangements

Confidence in governance arrangements was modest (mean=4.5). Around half of participants conveyed confidence in the regulation of future science and technology research. For example:

- 55.2 per cent believed that legislation and regulation can be counted on to ensure that future science and technology research is developed safely
- 51.5 per cent believed that governments can effectively mitigate any socially undesirable effects from new technologies through regulations





# Building trust in the research and innovation sector

Public trust in responsible innovation is critically important for the development and deployment of many new innovations. While transparency is a core tenet for many research organisations, the fact remains that many people lack a deep understanding of what actually takes place in research organisations – beyond what is communicated to the public. We explored how much public trust in the innovation sector is underpinned by public perceptions of responsible innovation.

Overall trust in the innovation sector was a combined measure, comprising (a) trust in Australian research organisations (i.e. universities, private companies, non-government organisations or NGOs, government agencies, and CSIRO) and (b) trust in the scientists working within those organisations. Figure 3 shows that trust in the innovation sector was good overall (mean=5.1), which is the mean of trust in research organisations and their scientists. Trust in research organisations (mean=5.0) was lower than trust in their scientists (mean=5.3) on average.

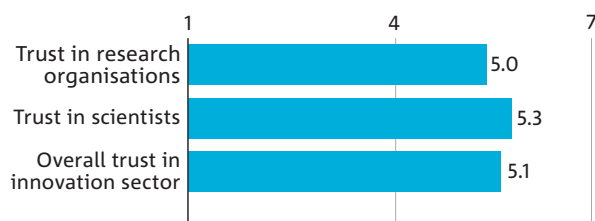


Figure 3 Trust in research organisations, their scientists, and the overall innovation sector (means)

Reviewing the individual items for trust, it was found that research organisations were most trusted for their competence (mean=5.3), though fewer participants agreed research organisations were open to public feedback (mean=4.6). Similarly, trust in the competence of scientists working in these institutions was also relatively high (mean=5.7) compared to their other trustworthy qualities: benevolence, openness, and integrity (mean=4.9).

## What is driving public trust?

Figure 4 shows the relative importance of each element of responsible innovation in explaining public trust in the Australian research and innovation sector.<sup>14</sup> Emerging as the top three predictors of trust were perceptions of scientists in the sector as being responsive (14 per cent) and reflecting on their research (12 per cent), and for the research to have effective risk management practices in place (11 per cent), together accounting for more than a third of trust in the sector (37 per cent). The results also showed that all these elements of responsible innovation were significantly correlated or inter-related, suggesting they all work together in explaining trust. Two-thirds of trust in the research and innovation sector (67 per cent) can be explained by these perceptions of responsible innovation. The remaining 33 per cent is explained by other factors. For example, the type of science organisation developing novel technologies (e.g., universities and private organisations) and individual participant characteristics (e.g., their belief in science).

<sup>14</sup> The relative importance of the predictors of trust were calculated using dominance analysis, a technique especially developed to examine the relative importance of predictors in multiple regression (see Budescu, D. V. (1994). Dominance analysis: A new approach to the problem of relative importance of predictors in multiple regression. *Psychological Bulletin*, 114(3), 542; Grömping, U. (2007). Estimators of relative importance in linear regression based on variance decomposition. *The American Statistician*, 61(2), 139–147).



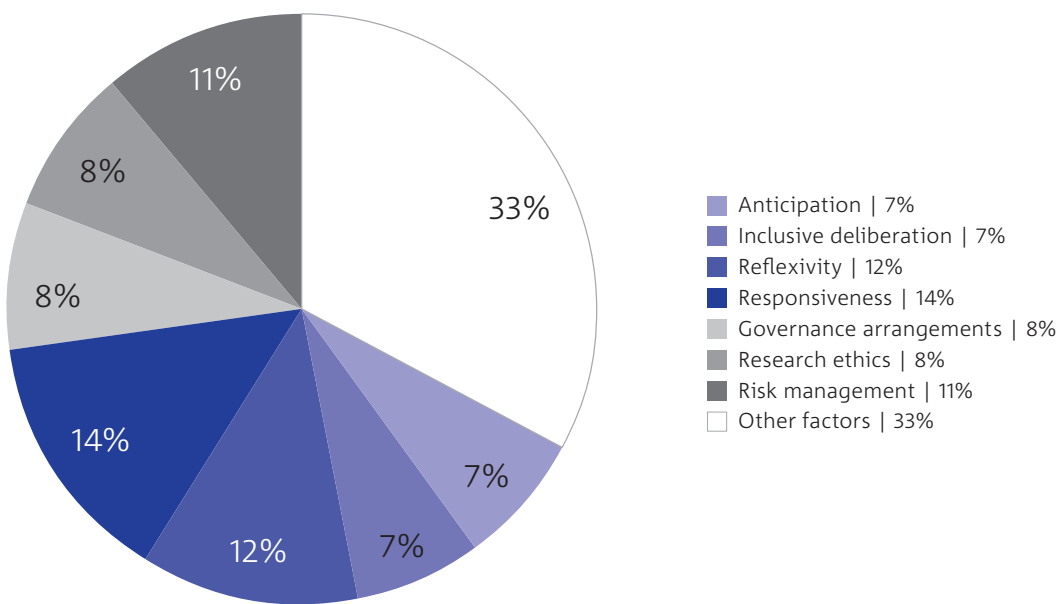


Figure 4 Predictors of trust in the Australian research and innovation sector (per cent explained)

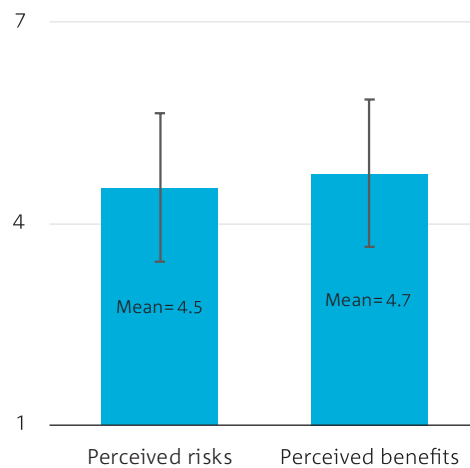
# Perceived risks and benefits of future science and technology

We know that risk management matters to public trust. At the same time, how people perceive risks and benefits of new and novel technologies may also affect public expectations about socially responsible outcomes.

To test the extent to whether this was the case, we first asked survey participants about eight example technologies and their potential uses, based on current Australian research projects and novel technologies under development. These examples include custom designed surgical robots as tools for a surgeon to treat an individual patient and gene editing to help control invasive pest species. See examples below.

Figure 6 shows that the average perceived risks and benefits were quite similar across these technologies, though perceived benefits (mean=4.7) were slightly higher than perceived risks (mean=4.5). The relatively even split between perceived risks and benefits suggests that participants perceived both risks and benefits associated with these technologies. The black lines in Figure 6 show the range of perceived risks and benefits for approximately two-thirds of participants, which was 1.1 either side of the mean. One third of participants had perceived risks and benefits outside this range.

Perceived risks and benefits vary between participants, and they will also vary depending on the technologies presented. However, the aim was not to individually assess



**Figure 6 Perceived risks and benefits across eight novel technologies**

Note: Blue bars show means and black lines show the range of perceptions for two-thirds of participants.

these eight different technologies, as participants did not have a detailed understanding of these technologies. The purpose of including perceived risks and benefits of novel technologies in this study was to explore their relative importance when predicting socially responsible outcomes.

## Examples of eight novel technologies:

1. Custom designed surgical robots as tools for a surgeon to treat an individual patient
2. Genome data to predict an individual's disease risk and prepare a treatment plan
3. Artificial intelligence to guide complex decision-making around important societal problems
4. Gene editing to help control invasive pest species
5. Genetic engineering of sea coral to make it more tolerant to warming oceans
6. Artificially engineered 'pseudo-organisms' to clean up polluted waterways
7. Drones informed by artificial intelligence for monitoring of urban environments
8. Quantum sensors to collect more accurate data on a person's location



# Delivering socially responsible outcomes

Given one of the main benefits of responsible innovation is to ensure socially responsible outcomes from future science and technology, what kind of outcomes matter? And what is the responsibility of the research and innovation sector to deliver those outcomes?

To understand what type of outcomes the Australian public deemed to be socially responsible, we developed a series of items to reflect different social purposes or outcomes that we might expect from future science and technology. Figure 5 shows the percentage of participants expecting various socially responsible outcomes. More than half agreed that these outcomes would be delivered while about 10 per cent disagreed. Still, between a quarter and third of Australians were more neutral, neither agreeing nor disagreeing. While most people agreed that new and innovative technologies would deliver socially responsible outcomes, many were unsure and some disagreed. These results suggest some wariness in the Australian population toward new technologies.

Nearly two-thirds of the general public believed that new science and technology would target critically important problems for society today and future generations (65.7 per cent). As such, most saw these future technologies as being in the public interest (62.7 per cent). However, not as many agreed that they would be socially responsible (57.1 per cent), and more than half thought that they may magnify inequities in society (56.0 per cent). These results suggest that future innovations and technologies may be seen as contributing to an unequal society at the same time as potentially benefitting society by targeting critical problems (i.e. seen as benefiting and impacting people unequally or differently).

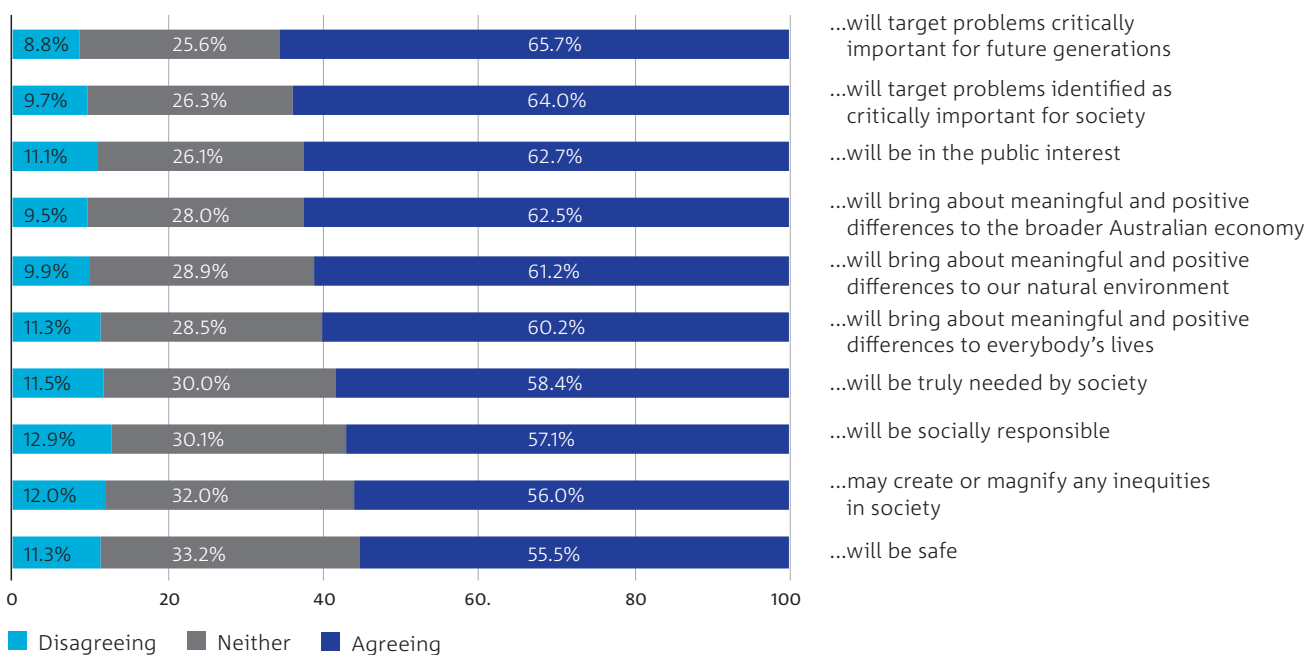


Figure 5 Expected socially responsible outcomes

Note: Percentage *disagreeing* answering 1, 2 or 3 on a 7-point agreement scale; *neither* answering 4; and *agreeing* answering 5, 6 or 7

In terms of where future technologies are seen as making the most positive difference – socially, economically and environmentally – they were seen as contributing similarly to each domain. However, more people agreed with the future technologies making a difference in the economy (62.5 per cent) than in their daily lives (60.2 per cent). This is consistent with fewer people seeing technologies as being truly needed (58.4 per cent), despite driving economic and other benefits.

Lastly, only 55.5 per cent of the general public believed that new technologies will be safe, while a third remained unsure. The relatively significant proportion of participants who indicated they are unsure about the safety of new technologies illustrates the importance of trust and risk management, but also that matters like safety are more likely to be ‘deal breakers’ when it comes to public confidence and trust in relation to future science and technology.

## What contributes to socially responsible outcomes?

Figure 7 shows the relative importance<sup>15</sup> of each element of responsible innovation in contributing to socially responsible outcomes, along with trust in the sector, perceived benefits, and perceived risks. The top three predictors of socially responsible outcomes were: 1) perceived benefits associated with future science and technology; 2) effective risk management practices being in place; and 3) trust in the research and innovation sector. These three factors together accounted for 40 per cent of public expectations for socially responsible outcomes. The remaining factors accounted for variation in socially responsible outcomes of between four to seven per cent, except for perceived risks which did not explain any variation in socially responsible outcomes. Overall the factors in Figure 7 explained almost three-quarters of perceived socially responsible outcomes (74 per cent). The remaining 26 per cent is explained by other factors outlined previously.

Science practices supporting responsiveness to society explained nearly a quarter (the purple wedges) and the other three elements of responsible innovation explained another quarter (the grey wedges). However, the relatively high importance of risk management suggests that this factor has a more prominent and direct role to play, while other elements of responsible innovation may have more indirect effects.

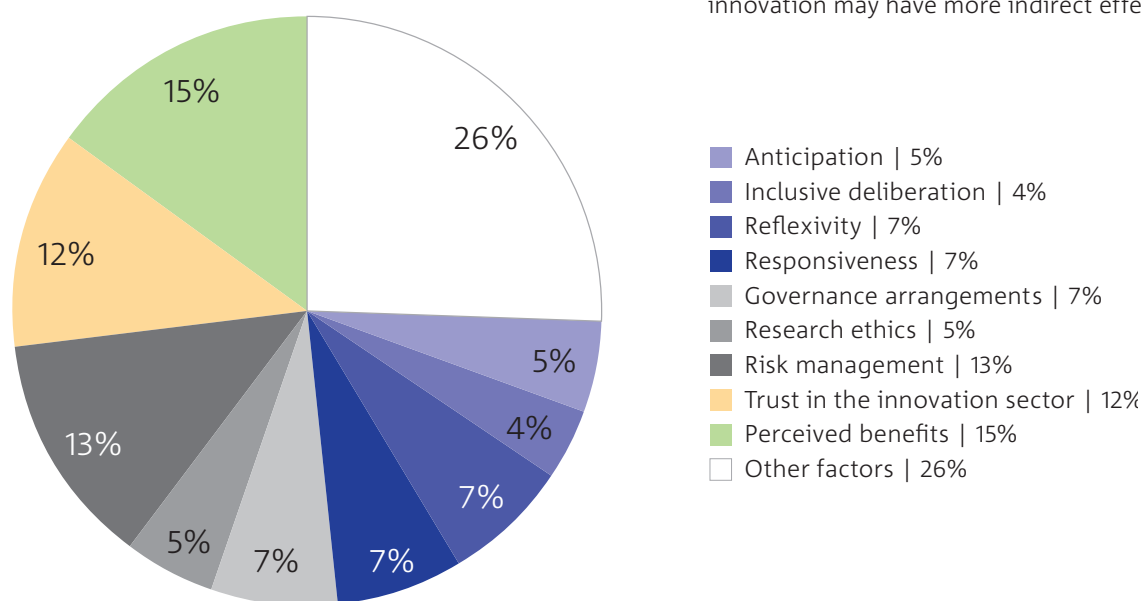


Figure 7 Predictors of socially responsible outcomes (per cent explained)

<sup>15</sup> Ibid.

# What does it all mean?

## How does responsible innovation work?

By developing survey measures to monitor what the Australian public think about different elements of responsible innovation, we can also begin to explore how responsible innovation works, in the eyes of the public. This is important as it takes us beyond theorising to quantifying the potential of responsible innovation to build trust in the innovation sector and achieve outcomes seen by the public as socially responsible.

Figure 8 provides a conceptual model of how we think perceptions of responsible innovation build public trust and expectations of socially responsible outcomes from future science and technology. The conceptual model developed from the survey results shows four elements of responsible innovation (at the top) fostering trust in the research and innovation sector (on the left). When we perceive responsible innovation in our research institutions, we are more likely to trust them. Conversely, if we don't think our research institutions are practising responsible innovation, we are less likely to trust them. Trust plus perceived benefits from novel technologies create expectations of socially responsible outcomes.

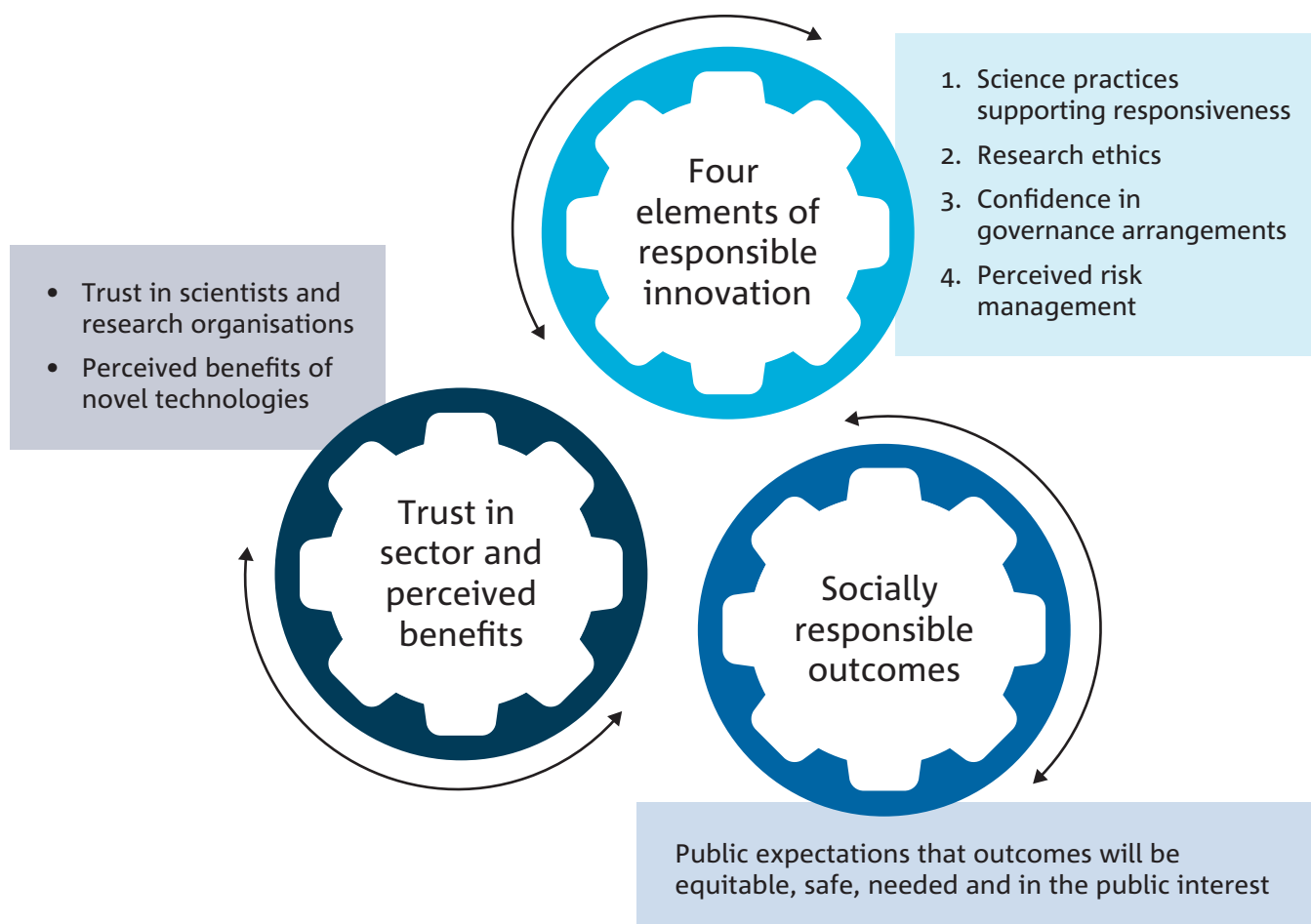


Figure 8 A conceptual model of how responsible innovation, trust and socially responsible outcomes fit together

Note: Perceived risks is not in this model because it did not significantly predict socially responsible outcomes.

Trust is a central ‘mediating’ factor in this model, lying between four key elements of responsible innovation and public expectations about socially responsible outcomes. The four elements of responsible innovation work indirectly by building trust in the sector. However, our results suggest that perceived risk management may also work more directly on expectations of social responsible outcomes. The results also suggest that perceived risks are not important in predicting socially responsible outcomes and are not shown in the model – only perceived risk management was found to be important.

We also show the arrows as bi-directional. Just as perceptions of responsible innovation can build trust in the sector, trust in the sector may lead to perceptions that scientists and research organisations are practising these four elements of responsible innovation. Similarly, just as trust can create expectations of socially responsible outcomes, outcomes perceived as socially responsible can also build trust in the research and innovation sector.

## Key findings

The results of this initial survey of public perceptions of responsible innovation suggest that:

- Australians hold modestly favourable perceptions of responsible innovation, on average, especially in terms of scientists anticipating the impacts of future science and technology.
- However, there is always room for improvement in public perceptions. The Australian public have less favourable perceptions of scientists being broad and inclusive when engaging with the public; and less confidence in the governance arrangements for regulating future science and technology research and development.
- Australians trust the research and innovation sector on average. However, they place more trust in scientists working within research organisations than in the research organisations themselves.
- Two-thirds of trust in the research and innovation sector can be explained by perceptions of responsible innovation, especially science practices supporting responsiveness to society and the perceived effectiveness of risk management practices.
- Three-quarters of public expectations about socially responsible outcomes from future science and technology can be explained by perceived benefits, trust in the research and innovation sector, and perceived risk management effectiveness.
- Provided potential risks are well managed, Australian society can accept potential risks with new technologies.
- These baseline results assessing perceptions of responsible innovation in Australia can now be used for monitoring changes in public perceptions of responsible innovation over time using reliable and valid measures.



## Conclusion

Having the trust and support of the Australian public for developing new and novel technologies that may pose potential risks is important for science to be able to solve some of Australia's greatest challenges. Public perceptions of responsible innovation are critical to building that trust and support. For example, engaging with the Australian public, key stakeholders, and potential users of technology helps to identify potential impacts and benefits which inform technology developments and build trust in the research and innovation sector. Conversely, an innovation sector that develops new technologies in line with societal needs, aspirations, and values earns trust and support by delivering socially responsible outcomes.

However, developing new technologies that can deliver socially responsible outcomes is not easy. The public do understand that there are risks alongside benefits in meeting some of our most critical technological challenges, and that these risks need to be managed. For example, working with personal data of all kinds to create new tools and services for Australians also requires that we carefully manage and protect the privacy of Australians.

The public also appreciate that new technologies can create inequities in society because impacts play out differently in different population segments, markets, and environments. However, the public were not as sure that outcomes from new technologies would be safe and fair compared to some other socially responsible outcomes. Ensuring both safe and fair outcomes of future science and technology requires the ongoing attention of the Australian research and innovation sector.

It is for these reasons that innovating responsibly is critical – essentially so that potential risks and benefits of future science and technology can be anticipated, better understood, and incorporated into the development and integration of new technologies into society. In doing so, new and innovative technologies may be designed and delivered in a way that is fair and of most benefit to all Australians.

As we embark on solving some of the greatest, most complex, and pressing challenges facing society today and into the future, an innovation 'compass' oriented towards socially responsible outcomes is a guiding value we can rely on to build trust and public support for developing new, novel and potentially disruptive technologies.

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