

# PRODUCT DESIGN SCOTLAND TOOLKIT



# 15 RESPONSIBLE INNOVATION FOR TECHNOLOGY DEVELOPMENT



WITH

Adam Smith  
Business School

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PRODUCT DESIGN  
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## ABOUT US

With a long tradition of innovation, entrepreneurship and commercialisation, the product design sector is one of Scotland's key industries. Through advances in technology, designers are providing innovative products across a number of global markets, including healthcare, energy, communications and mobility. Integration of these technologies into viable, efficient and commercially attractive products is key, and the partnership between technology and product design is becoming ever more important.

Product Design Scotland, managed by Technology Scotland, the representative body for Scotland's Enabling Technologies Sector, has been established to support the product and industrial design sector in Scotland. The network aims to be the focal point for the community, raising awareness of the critical importance of design to future growth and competitiveness and creating a thriving, collaborative network to drive innovation.

By working with companies and organisations across Scotland, we support the sector through:

- Promoting the value of strategic design to government and industry
- Raising the profile of Scotland's product/ industrial design sector
- Increasing visibility of those operating within relevant supply chains
- Improving competitiveness through collaboration and knowledge exchange
- Creating new networks to shape the future of design in Scotland.





# TOPIC INTRODUCTION

In a world of increasingly complex and rapid technological development, we are increasingly aware of the profound impact that innovations can have on society, the economy, and the environment. While innovations hold the potential to bring transformative solutions and enhance the quality of life, they also carry the risk of unintended consequences and exacerbating inequalities. This risk underscores the need for an emerging approach known as 'Responsible Innovation.' By embracing Responsible Innovation, organisations can navigate the ethical, socioeconomic, and environmental dimensions, ensuring that innovations are developed and implemented in an accountable, sustainable, and inspiring way. It is our collective responsibility to harness the power of innovation to create a brighter future where technological progress is aligned with the well-being of humanity and the preservation of our planet.

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## **WHAT IS RESPONSIBLE INNOVATION?**

Responsible Innovation (RI) is an interactive process that promotes creativity and opportunities for science, technology and innovation that are socially desirable and undertaken in the public interest in line with policy and organisations' interests. Innovation is a collective responsibility where funders, researchers, and interested and affected parties, including the public, all have an important role. RI aims to create new technologies and solutions that benefit society while minimising potential risks and negative impacts.

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## **WHY IS RESPONSIBLE INNOVATION IMPORTANT?**

Understanding RI can help organisations navigate the complexities associated with innovation by providing a structured approach to identify, assess, and address potential risks and opportunities. It fosters a culture of transparency, inclusiveness, and accountability, promoting interdisciplinary collaboration, stakeholder engagement, and long-term orientation. By embracing RI, organisations can enhance their reputation, mitigate risks, and contribute to long-term sustainability while ensuring that their innovations align with societal values and expectations.

RI aims to create positive and sustainable outcomes that benefit society, the economy, and the environment while mitigating potential risks. The societal impact of RI fosters the development of solutions that address pressing societal challenges, ultimately contributing to the well-being of individuals and communities. The economic impact of RI can enhance reputation, increase customer loyalty, and provide access to new markets, contributing to long-term economic growth and stability. Finally, the environmental impact of RI promotes sustainability, minimises negative environmental impacts, and supports the development of environmentally friendly products and processes.

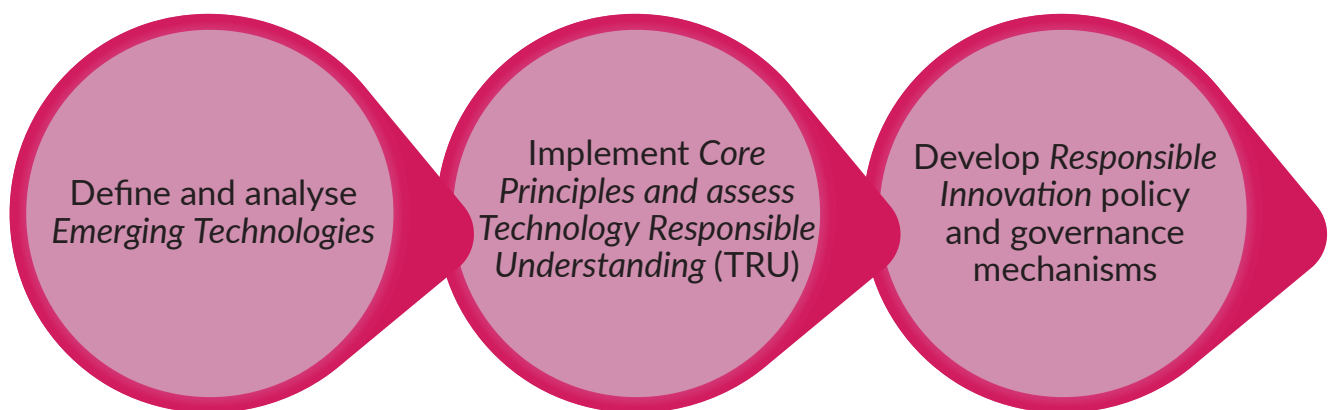


## HOW TO START ADOPTING RESPONSIBLE INNOVATION?

To effectively implement responsible innovation within their operations, organisations can introduce various mechanisms that ensure ethical, sustainable, and inclusive development and deployment of new technologies. Some initial steps include:

1. Describe and analyse emerging technology's social, economic, and environmental impacts, both intended and unintended.
2. Reflect on regulation, ethics, risks, and responsible forms of governance, through dialogue, engagement, and debate with a broad range of stakeholders (including technology providers, government bodies, workers, and society representatives).
3. Develop effective governance mechanisms for marketable, acceptable, and responsible business models for new technologies.

To further explore how organisations can implement responsible innovation, we will describe the Adam Smith Responsible Innovation Framework in the following section which provides a comprehensive approach to incorporating responsible practices for new technologies.





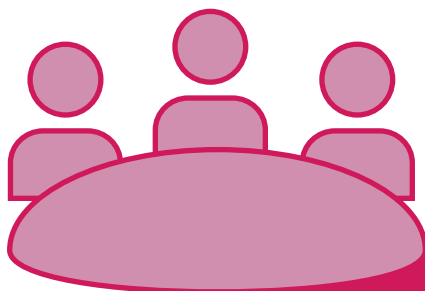
# **ADAM SMITH RESPONSIBLE INNOVATION FRAMEWORK**

Adam Smith Responsible Innovation Framework (AS-RIF) is designed to be forward-thinking and feasible. It encompasses key principles of Responsible Innovation (RI). This comprehensive framework aims to guide organisations in integrating RI principles into their new technology development process and practices, facilitating the development of technological solutions that address market needs and contribute positively to society and the environment. By implementing the AS-RIF organisations can actively work towards more sustainable, inclusive, and impactful technological innovations that deliver meaningful benefits while minimising new technology's potential risks and negative consequences.

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## CORE PRINCIPLES

Assessing RI can be challenging due to the complex and dynamic interplay of ethical, regulatory, social, and environmental factors that must be considered throughout technological innovation. To address this issue, the AS-RIF considers five Core Principles that structure the intertwined implications of emerging technologies.



### RI CORE PRINCIPLES

- Anticipation
- Reflexivity
- Inclusiveness
- Responsiveness
- Sustainability
- Transparency and Openness



## **1. ANTICIPATION**

Anticipation involves thinking ahead and considering the potential social, ethical, and environmental consequences of innovation before it is fully developed or deployed. By identifying potential risks and opportunities early in the process, organisations can better plan for and address these issues proactively, minimising negative impacts and enhancing positive outcomes.

- 1.1. What are the potential short-term and long-term consequences of the innovation, both positive and negative?
- 1.2. Have we conducted comprehensive risk assessments, including potential social, ethical, and environmental impacts?
- 1.3. How can we mitigate or address any identified risks and enhance the positive outcomes of the innovation?

## **2. REFLEXIVITY**

Reflexivity is the ability to reflect on one's assumptions, values, and practices and the wider social and institutional context in which innovation occurs. By fostering a culture of reflexivity, organisations can become more open to learning from their experiences, questioning their beliefs, and adapting their practices to better align with RI principles.

- 2.1. How do ideas, values, and practices influence the direction and outcomes of innovation?
- 2.2. Are we open to learning from our experiences and questioning our beliefs during innovation?
- 2.3. How can we foster a culture that encourages reflection and self-critique?

### **3. INCLUSIVENESS**

Inclusiveness in RI means actively engaging a diverse range of stakeholders in the innovation process, including those who may be directly or indirectly affected by the innovation. Stakeholders can include customers, employees, local communities, regulators, and other relevant groups. Organisations can develop more inclusive, equitable, and social RIs by involving diverse perspectives in decision-making.

- 3.1. Have we identified and engaged all relevant stakeholders, including those who may be directly or indirectly affected by the innovation?
- 3.2. How can we ensure diverse perspectives and experiences are considered in decision-making throughout the innovation process?
- 3.3. Are there any barriers to participation, and if so, how can we address them to promote inclusivity?

### **4. RESPONSIVENESS**

Responsiveness refers to the ability of organisations to adapt and respond to new information, emerging challenges, or stakeholder feedback. In the context of RI, this means being willing to change the direction of innovation, alter its design, or even abandon it altogether if new evidence or concerns indicate potential negative consequences. Responsiveness also involves being open to learning from mistakes and refining practices based on feedback and new insights.

- 4.1. How will we monitor and evaluate the progress and impacts of the innovation, and what mechanisms are in place to adapt or respond to new information or challenges?
- 4.2. Are we open to changing the direction of the innovation if new evidence or concerns arise?
- 4.3. How do we incorporate feedback from stakeholders and learn from mistakes or setbacks?

## **5. SUSTAINABILITY**

Consider innovations' long-term social, environmental, and economic impacts, and strive to develop solutions that contribute to the well-being of current and future generations without depleting resources or causing irreversible harm.

- 5.1. How does innovation contribute to long-term ethical, social, and environmental well-being?
- 5.2. Are there any potential trade-offs or negative impacts, and how can they be minimised?
- 5.3. How can we ensure that innovation is resource-efficient and resilient to future uncertainties?

## **6. TRANSPARENCY AND OPENNESS**

Promote a culture of transparency and openness by sharing information about the future application of technology, potential impacts on society, and potential risks with stakeholders and the public, fostering open communication and collaboration within and with external partners, and ensuring adherence to relevant laws, regulations, and ethical standards.

- 6.1. What information about the innovation, its potential impacts, and risks are we sharing with stakeholders and the public, and through what channels?
- 6.2. How do we foster open communication and collaboration within our organisation and with external partners?
- 6.3. Are we adhering to relevant laws, regulations, and ethical standards? How do we ensure effective governance throughout the innovation process?

These core principles provide a structured approach to overcoming the complexity inherent to RI by breaking it down into accountable components. Such a structured approach allows organisations to better understand, evaluate, and improve their performance in creating and implementing innovations. The assessment can help inform decision-making, refine RI practices, and enhance the overall impact and effectiveness of the organisation's innovations while ensuring they deliver meaningful benefits to society while minimising potential risks and negative impacts.





**TECHNOLOGY  
RESPONSIBLE  
UNDERSTANDING  
SCALE**

## **TECHNOLOGY RESPONSIBLE UNDERSTANDING SCALE**

Building on the RI core principles, the Technology Responsible Understanding (TRU) scale has been designed as part of the AS-RIF to assess an organisation's comprehension of new technology's implications and guide them towards more responsible practices throughout the innovation process.

The objective of the TRU scale is to help organisations identify and address potential ethical, social, and environmental issues as early as possible in the innovation process. Organisations can use the TRU scale to identify gaps in their knowledge and understanding and develop strategies to address them. The TRU scale, described in Table 1, can also help organisations benchmark their progress over time and progress towards more responsible innovation practices. Overall, the TRU scale can be a valuable tool for promoting RI and ensuring that new technologies are developed to maximise their benefits while minimising their potential negative impacts on society and the environment.

Table 1

<b>LEVEL</b>	<b>DESCRIPTION</b>	<b>OBJECTIVE</b>	<b>TOOLS</b>
TRU Level 1: Unexplored Technology	The technology is in its infancy, and there is little to no understanding of its ethical, social, or environmental implications.	Recognise the potential ethical, social, or environmental implications of an emergent technology.	Horizon Scanning
TRU Level 2: Initial Awareness	Preliminary awareness of the technology's potential implications and consequences emerges, but the understanding remains limited and speculative.	Develop preliminary scenarios highlighting the potential implications and consequences of the technology.	Foresight Scenario Planning
TRU Level 3: Conceptual Analysis	Researchers and stakeholders begin to systematically analyse the technology's potential implications and consequences, leading to a more comprehensive understanding.	Systematic analysis of the technology's potential implications and consequences based on available information.	Technology Assessment
TRU Level 4: Early-stage Risk Assessment	Potential risks and unintended consequences are identified and assessed, but the understanding remains partial and mainly theoretical.	Identification and preliminary evaluation of potential risks and unintended consequences associated with the technology.	Risk Assessment and Management
TRU Level 5: Experimental Exploration	Exploratory research, simulations, or small-scale experiments are conducted to understand better the technology's ethical, social, and environmental implications and consequences.	Empirical investigation of the technology's ethical, social, and environmental implications and consequences through research, simulations, or small-scale experiments.	Ethical Impact Assessment Social Impact Assessment Environmental Impact Assessment
TRU Level 6: Comprehensive Assessment	A thorough and systematic assessment of the technology's potential implications, indirect effects, and unintended consequences is conducted, providing a more complete understanding.	Thorough and systematic assessment of the technology's potential implications, indirect effects, and unintended consequences, integrating insights from previous levels.	Multi-criteria Decision Analysis (MCDA)
TRU Level 7: Stakeholder Engagement and Feedback	Stakeholders are actively engaged in understanding the technology's implications and consequences, leading to a more inclusive and diverse perspective.	Inclusion of diverse stakeholder perspectives in understanding and evaluating the technology's implications and consequences.	Stakeholder Engagement Deliberative Methods
TRU Level 8: Proactive Mitigation and Adaptation	Strategies for mitigating potential risks and adapting to unintended consequences are developed and implemented based on a comprehensive understanding of the technology's implications.	Develop and implement strategies to mitigate potential risks and adapt to unintended consequences based on a comprehensive understanding of the technology's implications.	Adaptive Management and Monitoring
TRU Level 9: Continuous Monitoring and Improvement	An ongoing process of monitoring, learning, and refining the understanding of the technology's implications and consequences is established, ensuring that responsible innovation principles are upheld throughout the technology's lifecycle.	Establish an ongoing process to monitor, learn, and refine the understanding of the technology's implications and consequences, ensuring responsible innovation principles are upheld throughout the technology's lifecycle.	Adaptive Management and Monitoring (ongoing)





**RESPONSIBLE  
INNOVATION  
TOOLS**

## **RESPONSIBLE INNOVATION TOOLS**

Finally, the following briefly describes the tools suggested in Table 1. By employing these tools, techniques, and frameworks, organisations can effectively navigate the complexity of emergent technologies, gain a deeper understanding of their potential implications and consequences, and progress in their Technology Responsible Understanding.

### **Horizon Scanning**

Systematically identify and monitor emerging technologies, trends, and developments with significant ethical, social, or environmental implications.

### **Foresight and Scenario Planning**

Develop and analyse multiple plausible future scenarios to anticipate potential implications and consequences of the emergent technology.

### **Technology Assessment**

Evaluate the technology from various perspectives, including technical feasibility, ethical, social, and environmental implications, and potential risks.

### **Risk Assessment and Management**

Identify, evaluate, and prioritise potential risks associated with the technology and develop strategies to mitigate or manage those risks.

### **Ethical Impact Assessment**

Analyse the technology's potential ethical implications, considering aspects such as privacy, fairness, transparency, and human rights.

### **Social Impact Assessment**

Examine the technology's potential social implications and consequences, including its impact on communities, social structures, and inequalities.

### **Environmental Impact Assessment**

Assess the potential environmental implications of the technology, considering aspects such as resource use, waste generation, and pollution.

### **Stakeholder Engagement and Deliberative Methods**

Involve diverse stakeholders, including experts, end-users, and affected communities, in the assessment and decision-making process using focus groups, workshops, and public consultations.

### **Multi-criteria Decision Analysis (MCDA)**

MCDA techniques systematically evaluate and compare multiple dimensions of the technology, including its potential implications and consequences, to support informed decision-making.

### **Adaptive Management and Monitoring**

Implement continuous monitoring, learning, and adapting to new information and insights about the technology's implications and consequences, adjusting strategies and actions as needed.



**RESPONSIBLE  
INNOVATION  
CONSIDERATIONS**

RI requires a series of considerations to serve as a guide to ensure that technological innovation is developed and implemented in a way that considers its potential impacts on society, the environment, and future generations. The following is a suggested set of considerations that can be used with the TRU scale to evaluate and compare different innovation initiatives, identify areas of improvement and best practices, and guide the development of responsible innovation strategies and policies.

### **Social and Environmental Impact**

The extent to which the innovation contributes to society's social and environmental well-being, considering its potential positive and negative effects.

### **Ethical Considerations**

The degree to which the innovation respects ethical principles, such as autonomy, justice, beneficence, and non-maleficence.

### **Stakeholder Engagement**

The level of involvement of relevant stakeholders, such as affected communities, customers, employees, and civil society organisations, in the innovation process.

### **Transparency and Accountability**

The level of openness and accountability of the innovation process and its entities, including access to information and disclosure of relevant risks and uncertainties.

### **Precautionary Measures**

The extent to which the innovation is designed and developed with a precautionary approach, considering its potential uncertainties and risks.

### **Long-term Sustainability**

The degree to which the innovation is sustainable in the long term, in terms of its economic, social, and environmental viability.

### **Adaptability and Responsiveness**

The capacity of the innovation to adapt to changing circumstances and feedback and to respond to the needs and expectations of stakeholders.

## **EXPECTED OUTCOMES**

The successful implementation of the AS-RIF is expected to lead to several significant outcomes. By integrating the core principles, TRU scale, suggested tools and considerations, organisations can create a more ethical, sustainable, and socially conscious approach to technological development. As a result, innovations will be better aligned with societal values, addressing the needs and concerns of diverse stakeholders. Moreover, organisations can anticipate and mitigate potential risks, adapt to changing circumstances, and contribute to long-term social, environmental, and economic well-being.

The AS-RIF can facilitate various outcomes that help ensure technology development and deployment align with ethical, social, and environmental considerations. Some examples of the expected outcomes are:

### **Informed Policies**

Including stipulations on stakeholder engagement, risk assessment protocols, ethical guidelines, and measures for transparency and accountability.

### **Risk Management Strategy**

Anticipating the innovation's potential short-term and long-term consequences.

### **Stakeholder Engagement Plan**

Guiding how and when stakeholders should be involved in innovation.

### **Adaptive Governance Mechanisms**

Focusing on responsiveness and adaptability can establish flexible mechanisms that adjust to new information, emerging challenges, and feedback.

### **Sustainability Protocols**

Ensuring innovations contribute to social and environmental well-being without causing resource depletion or irreversible harm.

### **Transparency and Disclosure Guidelines**

developing guidelines for information disclosure about the innovation, its potential impacts, and associated risks.

### **Feedback and Learning Systems**

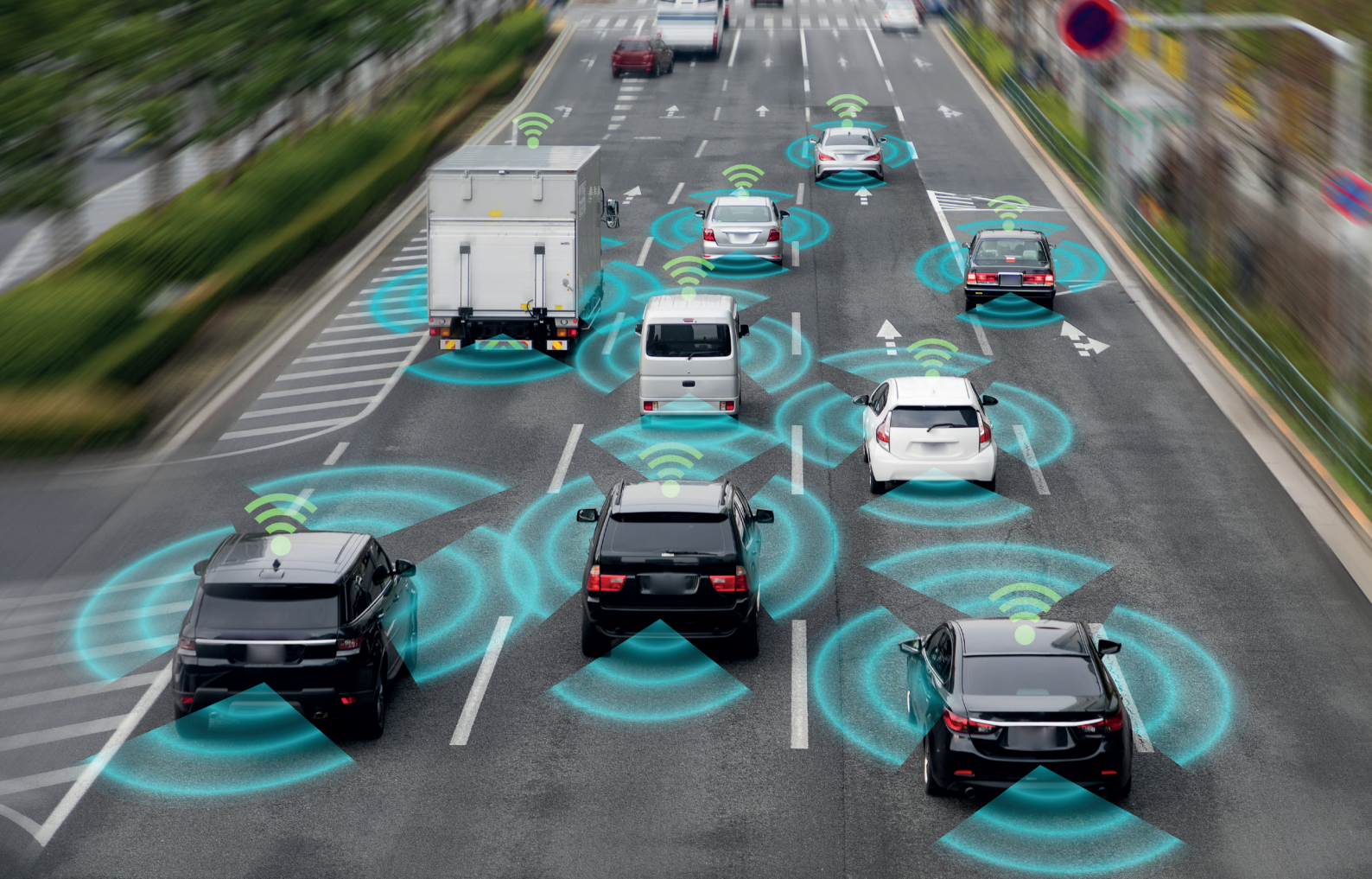
Establishing systems for continuous learning and improvement by using stakeholder feedback, monitoring the impacts of innovation, and refining understanding of the technology's implications.

### **Ethical Guidelines**

A set of guidelines that respect principles such as autonomy, justice, beneficence, and non-maleficence.



For example, companies can use these considerations to assess the potential impacts of new technologies and determine if they align with the company's values and goals. They can also use the considerations to engage with stakeholders and identify potential concerns or issues that should be addressed before implementation. Alternatively, policymakers can use these considerations to develop policies and regulations supporting responsible innovation and ensure that technological development aligns with broader societal goals. Policymakers can ensure that innovation is responsible, sustainable, and inclusive by considering the long-term impacts of new technologies and prioritising public engagement and participation. Ultimately, the AS-RIF aims to foster a continuous improvement and learning culture, enabling organisations to drive progress while minimising negative consequences for current and future generations.



# CASE STUDY

# CASE STUDY: AUTONOMOUS VEHICLES AND RESPONSIBLE INNOVATION

The development and implementation of autonomous vehicles (AVs) present an excellent opportunity to showcase the Adam Smith Responsible Innovation Framework (AS-RIF) application. As a technology with significant potential benefits and risks, it is crucial to ensure that AVs align with the principles of responsible innovation to maximise positive impacts and minimise potential harm.

## CORE PRINCIPLES

- **Anticipation:** By researching the possible impacts of AVs on traffic safety, urban planning, and employment, potential risks and opportunities can be identified and addressed proactively.
- **Reflexivity:** Reflecting on the potential societal implications of AVs, such as the digital divide, privacy concerns, and the consequences of decision-making algorithms.
- **Inclusiveness:** Engaging with various stakeholders, including vehicle manufacturers, city planners, public transport operators, and end-users, to incorporate their perspectives into AV development.
- **Responsiveness:** Adapting AV design and policies based on new information or feedback, such as incorporating safety features to address pedestrian concerns.
- **Sustainability:** Ensuring that AVs reduce carbon emissions, promote energy efficiency, and support sustainable urban development.

## TECHNOLOGY RESPONSIBLE UNDERSTANDING (TRU) SCALE

By applying the TRU scale, organisations involved in AV development can evaluate their understanding of the technology's implications, identify gaps in knowledge, and develop strategies to address them. For example, at TRU Level 7, stakeholder engagement and feedback can lead to a more inclusive and diverse understanding of AV impacts, informing better design decisions and policymaking.

## RI CONSIDERATIONS

The following considerations can be applied to the development and implementation of AVs:

- **Social and environmental impact:** assessing the potential positive effects, such as reduced traffic congestion and emissions, and negative impacts, like potential job losses in the sector.
- **Ethical considerations:** ensuring AV decision-making algorithms adhere to ethical principles and do not inadvertently discriminate against specific populations.
- **Stakeholder engagement:** involving relevant stakeholders in developing and regulating AVs, such as public consultation on urban planning adaptations and regulatory frameworks.
- **Transparency and accountability:** sharing information about AV technologies, potential impacts, and risks while adhering to relevant regulations and ethical standards.
- **Precautionary measures:** develop AVs with a precautionary approach, such as implementing rigorous safety testing and regulatory oversight.
- **Long-term sustainability:** assessing the long-term sustainability of AV technology in terms of energy consumption, infrastructure requirements, and societal impacts.
- **Adaptability and responsiveness:** adapting AV designs and policies based on stakeholder feedback, new information, or changing circumstances.

## OUTCOME

**Stakeholder Engagement Plan.** Organisations can anticipate and address potential challenges through consistent and meaningful engagement and cultivate public trust and acceptance of autonomous vehicles. Engagement with stakeholders such as potential users, regulatory bodies, city planners, and the wider public is vital from the early stages of innovation. Organisations can gain insights into various perspectives and potential concerns by actively involving these parties. The Stakeholder Engagement Plan can include processes and guidelines to address various aspects of the development, from practical issues, like how to integrate these vehicles into existing traffic, to more abstract questions, such as how to resolve ethical dilemmas in the case of an imminent collision.

## CONCLUSIONS

Applying the AS-RIF to AV development is an example of how organisations can ensure technological innovations align with ethical, social, and environmental values. By following the principles, TRU scale, and considerations of the RI framework, AV development can maximise benefits while minimising potential negative impacts, fostering a more responsible and sustainable innovation landscape.





University  
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# ADAM SMITH BUSINESS SCHOOL PROFILE

At the University of Glasgow Adam Smith Business School, our aims are to conduct world-leading research, provide research-led teaching and enhance the skills of our students. In contributing to the University of Glasgow's strategy, 'World Changers Together', the Adam Smith Business School embraces the values of being passionate, professional and progressive in supporting the School's organisation, development and culture globally.

## **Identity**

Adam Smith's legacy informs our values, reflected in him founding modern economics and writing holistically about society and human interaction. Resonating with Smith, we promote and reflect upon our values in being engaging, enterprising and enlightening.

## **Vision**

As a research-informed and professionally-focused business school, the Adam Smith Business School aspires to be world-changing, with distinct expertise in finance and enterprise.

## **Mission**

The Adam Smith Business School sustains and fosters a place of outstanding quality, research-informed and professionally-focused, bringing together inspiring people for the purposes of research, learning and teaching, and engaging with corporate and policy connections, with impact locally and globally.

## **Responsible Innovation**

In 2020, the Adam Smith Business School became an advanced signatory of the United Nations Principles of Responsible Management Education. This signalled our commitment to promoting sustainability and responsible management in our teaching, research and practice.

Toolkit developed by: Prof. Nuran Acur (nuran.acur@glasgow.ac.uk) and Dr. Carlos Carbajal (carlos.carbajal@glasgow.ac.uk ). If you have any questions, please contact them.





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