Check for updates

Futures & Foresight Science

WILEY

ORIGINAL ARTICLE OPEN ACCESS

Using Horizon Scanning to Build Policy Resilience: Case of Waste Crime

Kenisha Garnett[1] | Alister Wilson[2] | Edith Wilkinson[1]

[1]Faculty of Engineering and Applied Sciences, Cranfield University, Cranfield, Bedfordshire, UK | [2]Waverley Management Consultants Ltd, Alloa, UK

Correspondence: Kenisha Garnett (k.garnett@cranfield.ac.uk)

Received: 21 March 2024 | **Revised:** 21 October 2024 | **Accepted:** 26 October 2024

Funding: This research was commissioned and funded by the Scottish Environment Protection Agency (SEPA) as part of the Smarter Regulation of Waste in Europe, LIFE SMART Waste project, (LIFE13 ENV-UK-000549).

Keywords: foresight | futures | horizon scanning | resilience | waste crime

ABSTRACT

Waste crime is a pressing concern for the waste and resource industry as it is undermining investment, growth and jobs within the industry and threatening the natural environment. However, there is little knowledge of the scale of the problem, the types of criminality and motivations involved, and the precise nature of crime. Environmental regulators are building foresight capabilities to better understand the effect of current and future changes in markets, in technology and in the legislative environment on waste crime and associated behaviours. At the heart of this paper is the question: how can horizon scanning be adopted by environmental regulators to shape decision processes and build resilience to waste crime? We report our efforts to build a toolkit and guidance for conducting horizon scanning, aimed at supporting environmental regulators, investigators and intelligence analysts to build an understanding of—and interpretation of the consequences of—behavioural, market, technological and pollution trends in the waste sector. A review of the academic and grey literature provided insights to organisational approaches and design principles for public sector horizon scanning. Outputs guided discussion at a stakeholder workshop with waste regulators, criminal intelligence and industry professionals to explore institutional challenges and to agree broad design principles for a horizon scanning process. The toolkit supports environmental regulators in applying horizon scanning to policy and wider operational and delivery-focused challenges; learning how to: (1) spot weak signals and emerging trends quickly, (2) examine the evidence around potential threats and opportunities for the future, and (3) take action on strategically important issues to minimise the impact of crime on the environment, society and business. The paper sets out further research needed to integrate horizon scanning with data analytics (e.g., predictive and hotspot analyses) to challenge assumptions about the patterns of change, based largely on historical trends, and to better manage these so there is greater adaptability to current and future trends.

1 | Introduction

Current challenges around waste management have highlighted waste crime as a criminal mainstream activity akin to a 'new narcotics' (Bevan 2022). Waste is considered amongst the nine sectors[1] likely to become a victim of underworld interest (Beken 2004). Increasingly regarded as part of the collection of modern crime, illegal waste management brings tangible benefits to its perpetrators in the form of economic savings resulting from the bypass of costly environmental compliance (Almer and Goeschl 2015). Thus, waste crime is a pressing concern not just for the waste and resource industry as it undermines investment, growth and jobs within the industry, but for society as a whole as "it causes widespread and significant

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2024 The Author(s). *Futures & Foresight Science* published by John Wiley & Sons Ltd.

harm: to people, places, the economy, to law and order, and to the environment" (Bevan 2022). Waste crime can be understood and defined as breaking the law in relation to the disposal and management of waste. In the UK, the Environment Agency (2017), in its efforts to tackle waste crime describe three key areas of concern:

- Illegal waste sites, defined as "a site operating without the appropriate permit for the activity being carried out where multiple loads of waste are deposited, treated, stored or disposed of, and where activity is, or appears to be taking place in an organised manner." (Environment Agency UK 2017, 3)
- Misdescription of waste "occurs when an operator fails to assess, characterise and classify a waste correctly. That includes the failure to apply the correct waste classification code or provide an adequate written description of the waste. This is sometimes done deliberately to reduce disposal costs and evade paying the correct rate of landfill tax." (Environment Agency UK 2017, 7)
- Illegal waste exports are defined as "a breach of the 'Waste Shipment Regulations (EU)' (Regulation (EC) No. 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste), Transfrontier Shipment of Waste Regulations 2007 or the Waste Electrical and Electronic Equipment Regulations 20061 depending on the type of waste, that is, involved." (Environment Agency UK 2017, 4).

Worldwide, the waste sector, as other large economic sectors (UNEP estimates it to be worth USD 410 billion a year) presents many opportunities for crime, where illegal activities are increasing due to the low detection and punishment and high profitability of crime (Brown et al. 2017). Nonetheless, the scale of the problem, the types of criminality and motivations involved, and the precise nature of crime are not fully understood and determined. Previous commentary has established that serious waste crimes occur in diverse ways; from subjecting communities to toxic material through to tax fraud or money laundering in sectors where business interests conflict with environmental legislation and tax laws and cases of breach are motivated by profit (Rucevska et al. 2015). The UN Under-Secretary General and UNEP Executive Director warned that:

> *"The evolution of crime, even transnational organised crime, in the waste sector is a significant threat. Whether the crime is associated with direct dumping or unsafe waste management, it is creating multi-faceted consequences that must be addressed". Achim Steiner (in Rucevska et al. 2015, 4).*

The scale of the problem is not well understood, waste crime, but it is thought to have worsened in the UK over the past few years. It is believed to have become endemic with 18% of all waste (or the equivalent of 34Mt of waste) believed to be illegally managed (Environment Agency UK 2021). The Environmental Agency reports hundreds of illegal sites as well as increasingly widespread practices of dumping, burning, and burying unlawfully. Pollution of the environment through misdescription of hazardous substances is expected to cause long-term damage across the country (Bevan 2022). Besides, misdescription is also seen to be a primer for illegal export; it requires dedicated approaches to identify and investigate suspect containers destined for transnational illegal shipments (Environment Agency UK 2021). The European Commission (EC) raises an alarm on this all too often unreported or uncovered crime by highlighting some of its worrying characteristics (European Commission 2024). The EC claims that waste crime is transnational in nature, organised and interconnected with other crimes including corruption, tax evasion and money laundering. It is also a 'white collar' crime, which means that the illicit activities can be "committed by nonphysical means and by concealment or guile" (European Commission 2024).

Rapid growth of new markets, companies, and behaviours in the waste management sector, coupled with increases in the number and extent of deliberately illegal and otherwise non-compliant waste management practice has introduced challenges for regulators across the UK. Traditional regulatory implementation is finding it hard to adapt and respond to evolving markets and the new opportunities and constraints that are introduced. To address new challenges and opportunities, regulatory authorities are building horizon scanning and broader foresight capacity to better understand how current and future changes in the market, in technology and in the legislative environment can influence waste crime and affect behaviours. Thus, at the heart of this article, the authors explore the question: *how can horizon scanning be adopted by environmental regulators to shape decision processes and build resilience to waste crime?*

The article is divided into four sections in response to this question. The first provides an examination of resilience as an outcome of strategic decisions about risks and uncertainties. It explains how horizon scanning contributes to policy processes and enables 'weak signals' and 'surprises' to be investigated in a systematic way. The article then turns to methodologically oriented sections where the approach to the study is described. The approach comprised of a keystone literature review to explore the purpose and value of horizon scanning in public sector organisations and a stakeholder workshop to adapt public sector scanning applications for use in an environmental regulatory context. The third section clarifies the fundamental functions of horizon scanning: intelligence-gathering, sense-making and taking action, outlining key design questions and appropriate tools that are applied to assess policy and wider operational needs. Finally, concluding comments draw the readers' attention to the benefits and cultural challenges of applying horizon scanning tools.

2 | Horizon Scanning: A Tool to Build Policy Resilience

Horizon scanning is a strategic planning tool used in public sector organisations to identify important evidence needs and gaps and to integrate longer-term thinking into policy making. Often, the focus is on complexity around policy and implementation challenges to help inform and review strategic

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

direction (Institute of Risk Management IRM 2018). Horizon scanning is a systematic way of looking beyond current trajectories, distinguishing between different forms of change (i.e., constant, incremental, volatile or rapid change) to focus on weak signals[2] as well as persistent problems and trends, carry out comprehensive assessments of all sectors, and address issues at the margins of current thinking. The most common definition of horizon scanning (also referred to as environmental scanning, external scanning, and strategic scanning) was coined by the UK Department for Environment, Food and Rural Affairs (Dalton 2002), and later amended by the UK Government Chief Scientific Advisor's Committee (CSA in Dalton 2002):

> *...the systematic examination of information to identify potential threats, risks, emerging issues [including weak signals] and opportunities, and their likely future developments including—but not restricted to—those that are at the margin of current thinking and planning.*

In an April 2014 report by the UK House of Commons Science and Technology Committee, the use of horizon scanning for strategic decision-making was clarified:

> *...it can help organisations to detect signals, identify trends and think more inventively about what the future might hold, enabling them to capitalise on opportunities and better mitigate threats. It is a crucial activity for any organisation tasked with long-term decision-making.*

Scanning builds an understanding of multiple ways that future events may unfold, thus challenging assumptions and exploring uncertainty. Emphasis is placed on being "aware of what is new or changing" and requires reflecting on both intended and unintended effects of change that could have a significant societal and policy impact (Institute of Risk Management IRM 2018). van Rij (2010) reviewed horizon scanning activities in 15 European countries, including the UK, and concluded that there are a common set of defining characteristics that depict a horizon scanning process (Table 1).

Given the complex and changing environment in which policy sits, horizon scanning practitioners have argued for a full exploration of the dynamic factors (e.g., social, political and market drivers) operating within the organisational landscape. The processes are both 'alerting and creative' as they enable the detection of early warning signals as well as the interpretations of these signals and development of insights to shape responses (Institute of Risk Management IRM 2018) Thus, horizon scanning processes link directly to risk and uncertainty management and can "be thought of as stop rules (against the board's search for profitability) and as search engines (scanning the horizon for new risks and opportunities)" (Schiller and Prpich 2014, 1011).

The challenge, however, is the interpretation of signals of change that are 'weak', where the details and impact of emerging issues are usually uncertain and difficult to anticipate (European Food Safety Authority EFSA et al. 2018). Building an understanding of the uncertainty around the probability of occurrence and the potential consequences of emerging issues is important. Making a judgement about the 'knowability' of the issue, characterised by a typology of surprises, enables risk managers to build a repertoire of responses. In this paper, surprises are categorised as (i) discrete and foreseeable, (ii) cross-scale discontinuities, and (iii) 'out of the blue' disruptive phenomena (Brooks 1986, Gunderson 1999, Folke et al. 2007).

TABLE 1 | Characteristics of a horizon scanning process.

Characteristics
Systematic process that captures emerging signals, issues and trends for an actor/stakeholder, often grouped by themes/factors of interest, to support strategic discussions, decision and actions in the organisation.
Capturing **all signals** that could **significantly impact** the strategic goals and inherent values of the organisation and its stakeholders.
Ability to **look ahead** as far as possible (restricted by our cognitive abilities) and the purposeful inclusion of **weak signals of change** that challenge our current thinking.
Analysis of weak signals (or emerging issues) and their **possible interactions**, including cross-cutting challenges and their relevance for strategic planning.
Continuous scanning to capture new signals and trends, but also to observe what has changed, and how responses may need to be adapted.
Participatory process, involving a range of stakeholders during the collection of information, and to guide the interpretation and synthesis of that information, creating opportunities to shape or inform policy.

> *"These three types of surprises are, of course, interrelated. Discrete events may be the trigger for a permanent change in long-term trends. New information may be the result of discontinuities in long-term trends that had been latent but took a long time to become apparent. Much new information is such that we realise we should have known about it if we had only had the sense to look for it" (Brooks 1986).*

The repertoire of responses to each type of surprise reflects the analytical tools that are available to foresee them. Such tools rely on the 'knowability' of an issue or emerging threat, and the ability to detect early signals. New information resulting from discontinuities or 'weak signals' are defined as unclear observable trends or patterns that warn us about the possibility of future events (iKnow 2016, Palomino et al. 2013).

Table 2 encapsulates various tools and approaches to detect emerging issues associated with waste crime, including foresight tools, scanning of the internet for information, citizen science and state-of-the-art monitoring technologies used to analyse trends (European Commission 2016). For each domain and surprise type in Table 2, measures to promote adaptation and resilience have been highlighted.

The types of domains (first column at Table 2) are aligned with the three types of surprises described earlier (Brooks 1986;

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

TABLE 2 | A typology of 'surprises' and indicators in the waste crime context.

Domains	Surprises and typical signals	Indicator type and examples in the waste crime context		Ability to detect indicator (methods of analysis)	Measures to promote adaptation and resilience
Foreseeable domain	Trends (predictions)	Crime forecasts (e.g., predictive analytics)	'Site' operational indicators that regulators recognise and understand regarding the likelihood of an increased chance of non-compliance or crime (e.g. noise, odour, unusual operating patterns that are often causes of complaints)	Easy, somewhat easier to detect (e.g. hot spot analysis, trend impact analysis)	• Risk management based on risk or threat assessments and compilation of information and calculation. • Planning is locally owned—reliant on identification of scenario archetypes and business continuity protocols.
"Cross-scale" domain	Counter trends (discontinuities)	Regulatory changes Financial or market dynamics	'Non-site' operational indicators around market and supply chain relationships where regulators display various levels of understanding and awareness (e.g. incongruent or illogical supply-chain relationships in moving waste between sites or financially vulnerable sites embarking on non-compliant operations)		• Monitoring of large-scale consequences and systemic effects. Consideration of exposures and reversibility. • Variety of actors engaged in defining acceptability and participatory approach to solutions. • Agility and flexibility in decision making promoted. • Diversification
"Out of the blue" domain	Emerging issues and weak signals (including wildcards or black swan events)	Political, economic or social drivers Motivations or behaviour of supply chain operators	'Site' and 'non-site' operational indicators that regulators neither recognise nor understand such as market, technological and legislative pressures that may create opportunities for waste crime	Hard, not possible to detect (e.g. driver analysis, weak signal analysis)	• Vigilance and scepticism • Reorganisation, and renewal capacities • Learn (for the future—capture feedback and lessons) • Participatory processes including involvement of communities to make committing crime more difficult and riskier (target hardening).

Source: Cranfield University (2016), Delaney (2014), NATO (2002), Wilkinson and Cleary (2021).

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Gunderson 1999; Folke et al. 2007). The *'foreseeable' domain* is characterised by risks amenable to predictions and where unexpected discrete events or accidents prevail. In this domain, the systems boundaries are delineated, and critical processes are characterised; thus, waste crime indicators will rely on predictive analytics predominantly based on 'site' or operational data.

Within the foreseeable domain, current action by industry and environmental regulators tends to rely on the ability to produce evidence that has a high degree of rigour to assess the threat from and devise measures to prevent waste crime or criminal behaviour. This desire for evidence has promoted the use of intelligence-led policing (ILP) approaches that analyse crime patterns to understand offenders, victims, and contexts as a basis for making decisions about resource use to prevent and reduce crime.

The UK Environment Agency, for example, trialled an ILP approach to reduce illegal export of hazardous waste (Gibbs, McGarrell, and Sullivan 2015). ILP uses predictive analytical methods to collect and analyse information about crime and produce intelligence outputs that help environmental enforcement agencies target serious offenders to disrupt and prevent crime. Predictive analytics utilise existing data (e.g., market-based, demographic/social and spatial-temporal) to identify geographic features, individual profiles and behavioural characteristics that increase the risk of crime (Perry, McInnis, and Price 2013). The benefit of predictive analytics in this context is well known (Carter 2021, Gibbs, McGarrell, and Sullivan 2015; Carter and Carter 2009; Cope 2004), but such methods tend to drill down into the data to get a 'single' view of *what has happened in the past*, how it has impacted on *what is happening now*, and *what is likely to happen in the future*. In a waste crime context, this refers to:

- retrospective/diagnostic analytics that allow analysts to learn about what has caused a criminal activity or incident that has already occurred including the prevailing conditions and stimuli (e.g., triggers or factors) leading to the event
- predictive analytics that allow analysts to derive trends or patterns from the data, which help to determine what is driving criminal activities and behaviour to predict what future problems/threats are likely to emerge.

There are, however, concerns that predictive analytics may lead to a reliance on data sources and monitoring practices that deal largely with well-identified risks (e.g., site-based indicators of crime such as unusual operating patterns that are often causes of complaints) and fail to forewarn us of the new or emerging threats. Research suggests some ILP approaches have failed because they do not effectively integrate with traditional investigation procedures and problem-solving techniques, based on intelligence gathered from experienced police staff on the ground (Cope 2004) and cognitive tools (e.g., strategic foresight) that support early detection of indicators of crime (European Commission 2016).

The *'cross-scale' domain* presents discontinuities in long-term trends. Complex and unidentified interactions that can lead to unsustainable practices leading to shifts in the way systems[3] function. Although partial information may exist about the risk or threats, key indicators of waste crime will likely be external or 'non-site' such as regulatory changes, financial or market dynamics. A challenge in this context will be aligning or making sense of varying interpretations about predictions, tolerability, and management priorities. Large-scale phenomena bringing about profound change and long-lasting impacts are described by Suvantola and Kankaanranta (2018) as 'megatrends'. Often rooted in slow social, economic, political, environmental or technological large-scale trends such as world population growth, urbanisation or shifts in production and consumption patterns (influencing circular economies and the demand for secondary raw material) megatrends are expected to affect illicit waste trafficking. For instance, higher standards for waste management (through stricter traceability, labelling or book-keeping procedures) could raise the appeal of illegal operations to minimise costs of treatment and disposal. Conversely, counter trends in the sector would be epitomised by initiatives which make disassembly and recycling more profitable; for example if technology or know-how enabled enough valuable components or precious metals to be extracted more easily from e-waste products (Suvantola and Kankaanranta 2018).

In contrast, the *'Out of the blue' domain* is dominated by 'wild cards' or 'black swan events' that are beyond memory, experience and often imagination. In this domain, building resilience may rely on making sense of the changes that are required. The latent issues revolve around drivers and motivators for waste crime as well as underlying vulnerabilities in the system. No specific type of information source can be designated in this context, yet processes of questioning assumptions and capturing lessons will provide the basis for understanding pressure points and reorganising to build capability (and resilience). Understandably, signals are more difficult to grasp and to scan as this domain deals with the emergence of new information. Making sense of the information is therefore more challenging. Public policies aimed at triggering behavioural change can provide some examples. Considering a mix of economic incentives and stricter inspections to promote socially approved behaviour and encourage compliance with waste regulations, D'Amato et al. (2018) argue that unexpected effects can occur. Paradoxically, adopting harsh and punitive approaches can reduce the commitment to perform correct waste practices and increase waste related violations. The authors refer to a 'crowding out' of intrinsic motivation which ultimately offsets the impact of inspections in terms of deterrence.

Within the cross-scale and 'out of blue' domains, identifying weak or early signals requires different monitoring approaches and tools, and inherently different levels of scrutiny. Horizon scanning provides a structured process for considering crisis and breakthrough events which disrupt the status quo and can also stimulate the evolution and growth of new networks and structures. Often signals that are weak[4] emerge from disconnected data or 'chatter' in less tangible information sources (e.g. news alerts, social media), but can form part of a larger pattern when viewed through a specified frame or connected with other information sources (Palomino et al. 2013).

Horizon scanning can be brought together with other risk-based tools in a 'strategic intelligence' system to detect divergent signals of change. Its value lies in capturing a broad category of

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

signals across the supply chain and discerning where emerging threats and possible opportunities arise to identify potential strategies to mitigate or adapt to these.

3 | Methodology

3.1 | In-Depth Review of the Literature

We first carried out an in-depth review of the literature to build an understanding of the 'value' of horizon scanning in public sector organisations.

3.1.1 | Search Strategy

A literature search was carried out on three databases, Scopus, Web of Science, and Environment Complete for academic papers without restrictions on the year of publication. A similar search of the grey literature (e.g., research or government reports) was carried out on Google and Google Scholar and also 'fringe' sources such as consultancy websites, technical reports, among others. A search protocol was developed and implemented, using the keywords (e.g., "Horizon scanning" AND "tools" OR "methods" OR "techniques" OR "approaches" AND "health" OR "defence/security" OR "infrastructure/transport/utilities" OR "business/corporate" etc.).

3.1.2 | Evaluation and Selection of Sources

Our search of the published literature yielded 389 records from three databases, of which 86 were duplicates and 265 deemed to have insufficient and or irrelevant information for the review. A search of the grey literature retrieved a number of published reports, and an initial appraisal of the documents retrieved was carried out to assess 'relevance' by reviewing titles and abstracts. In some instances documents retrieved were 'scan read' to determine relevance. We drew on the extensive experience of the authors in horizon scanning to assess the quality of sources, based on quality indicators such as methodological rigour, auditability, validation and objectivity (Bowden 2004). Where there were challenges around the quality of sources, we excluded these from the review and supplemented information gathered with our own reflections on the appropriate uses and applications of horizon scanning in the public sector. A total of 48 articles were deemed relevant and of appropriate quality to inform the review.

3.1.3 | Synthesis of Information

The review enabled us to classify horizon scanning methodologies according to their context (e.g., subject/topic and objectives), phase of application (i.e., early recognition, preliminary assessment and analysis of significance of emerging threat) and scale of application (UK, EU and international). A summary of the different approaches collated included descriptions of the methods and tools used, actors involved, deliverables, timelines and resources (where applicable). This was accompanied by our own assessment of the suitability of designs for use by environmental regulators, highlighting their specific strengths and weaknesses and fit-for-purpose (e.g., its utility in public sector organisations).

3.2 | Stakeholder Workshop

The literature review established the context of horizon scanning applications in the public sector (i.e., its salient features and success factors), but it did not identify a 'fit-for-purpose' horizon scanning approach that could be adopted (as it exists) for waste crime. Hence, there was a need to draw on insights gathered from a stakeholder workshop to select the most viable combination of horizon scanning tools and techniques needed to build a customised process that met the needs of environmental authorities, ensuring the toolkit's relevance and utility for waste crime. Hence, we ran a 1-day stakeholder workshop bringing together 23 representatives from government agencies, environmental regulators, law enforcement, waste management companies and waste industry professional bodies to define a suitable horizon scanning approach for the waste sector. The workshop was designed to gather a wide range of opinions about what makes a horizon scanning toolkit useful, rather than to set out a detailed design specification (see agenda in Appendix 1). The objectives were to:

- Explore the *needs and challenges* around horizon scanning in the waste sector.
- Define *key design consideration and requirements* of a horizon-scanning tool.
- Evaluate expectations around the *end-user experience*.

Participants were split into three stakeholder groups (regulators, investigators and practitioners, intelligence analysts) to discuss their specific needs for a horizon scanning tool and common concerns around implementation, using the following questions to prompt discussion:

- What are your views on the challenge of horizon scanning in this area (i.e., waste crime)?
- What do you believe a toolkit can deliver—and what can it not deliver?

Next, we introduced key design considerations for horizon scanning (see Appendix 2) to support participants in discussing the range of tools and techniques that could be employed to help deliver smarter regulation of waste. In breakout sessions of randomly mixed groups, participants were tasked to review and critique a synthesis of different scanning methodologies (i.e. outputs of the literature review) and provided feedback on: (a) the relative strengths and weaknesses of approaches, (b) the practicality of different scanning options in an evidence-based policy context, and (c) the desirable characteristics of a horizon scanning process needed to address strategic uncertainties and deliver smarter regulation of waste. Recognising horizon scanning depends heavily on how well it meets the needs and expectations of the end users, we posed a final set of questions to explore participants expectations around the end user experience.

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

- What must the toolkit deliver for users?
- What would you ideally like the toolkit to deliver for users?
- What will make users confident in using the toolkit?

4 | Horizon Scanning Toolkit

Given public sector horizon scanning approaches vary depending on specific goals, resources, and policy environment, it was important to explore the needs and challenges around horizon scanning to narrow focus on common themes that set out specific requirements for horizon scanning and expectations around the end user experience. The information collated at the workshop was distilled into a core set of desirable characteristics of a horizon scanning process, and linked to core design functions, reported in the literature (e.g., Luís et al. 2021; Garnett et al. 2016):

- an *intelligence-gathering function* to facilitate early recognition of threats or signals of waste crimes, applying procedures to monitor and capture relevant information on a wide range of issues (e.g., political, economic, societal, technological legislative and environmental trends and developments) in a consistent and accessible document.
- an insight or *sense-making function* that transforms data into knowledge to better inform decision-making and policy formulation. This should guide regulators in agreeing the strategic importance of emerging threats and opportunities; and scope (using visualisation tools and indicative scoring) the scale and potential impacts of issues.
- an *action function* that guides the development of focussed and shared policy or regulatory responses and inform timely intervention.

Sections 4.1 to 4.2 present each function of the toolkit, outlining key design questions and appropriate tools that are applied in public sector scanning to assess policy and wider operational needs and challenges, incorporating considerations from the workshop to adapt the toolkit design to meet user expectations.

4.1 | Intelligence-Gathering

The complexity of criminal activity in the waste industry often requires collaboration between government departments or broader interagency collaboration to inform horizon scanning. Criminal behaviour is often opportunistic, and some perpetrators of crime are finding creative ways to get around the law, requiring authorities to be equally creative. The Joint Unit of Waste Crime (JUWC)[5] has said that horizon scanning for new and emerging trends around criminality can help authorities to think differently about what new forms of crime could arise (JUWC in Circular 2023). Detecting early signals of waste crime requires an intelligence-led system that gathers macro-level information about how the landscape is changing, the nature of vulnerabilities and motivations for crime (Heckenberg and White 2011), where scanning approaches vary depending on the context and information needs, and the time and other resources available. (Box 1, Cranfield University 2016, 1).

BOX 1: | Key design questions around the purpose, breadth, and depth of a scan

- Should the scan be broad, focusing on indicators of crime at a macro level (i.e. across whole supply chain operations)?
- Should the scan focus on specific issues, looking to fill analytical gaps by examining indicators of crime at a micro level (i.e., in a particular problematic area or regarding a problematic waste stream)
- If both types of scans are desirable, what is the right balance between the two?
- What is the right time horizon for scanning (e.g., 5, 10+ years ahead?)

Public sector horizon scanning tends to include diverse stakeholders from relevant government agencies to capture different policy perspectives. Scanning processes are often implemented by external consultants working with small in-house multidisciplinary teams that are knowledgeable about the problem and policy context. This provides a useful knowledge base for the team, but at the same time the diverse disciplinary backgrounds allow for considering different perspectives of the problem and capturing a wider range of signals (Cuhls et al. 2015; Bengston 2013). Such collaboration helps to ensure the interpretation and analysis of scans are meaningful, their outputs are relevant to the policy context and are effectively communicated to senior officials (Day and Schoemaker 2005).

Prior reviews of horizon scanning programmes have revealed two common approaches to scanning, and the pros and cons of each (Table 3):

Scanning for signals can be issue-focused or exploratory depending on context and information needs, and the time and other resources available to the organisation. The workshop highlighted the need to identify overlapping sector issues that shape change in the waste sector so scanning can be more targeted, narrowing down to common areas or issues that are most relevant to stakeholders to increase the impact of insights. Issue-focused scans fill analytical gaps by examining indicators of crime at a micro level (i.e., in a particular problematic geographical area or regarding a problematic waste stream) and are useful for identifying short-term responses needed to address emerging issues, often within the foreseeable domain (Table 2). They identify signals of relevance to waste crime using specified searches of the literature or via discussion with industry experts. Scanning for specific issues of waste crime is a good way to look at the problem from a different perspective. This might involve focusing on, say, generic crime or criminal behaviour rather than on waste-related crime and capturing articles that analyse how crime is changing (i.e., factors causing crime, triggers of criminal behaviour), and the lessons learnt that could reveal new and interesting behaviours applicable to the waste industry. A more focused scan may also look at, for example, particular waste trends or issues of strategic importance at specific points in the planning cycle. In such instances, a more targeted search would be needed, for example, examining the

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

TABLE 3 | Common scanning methods.

Scan approach	Methods/techniques	Description	Pros and Cons
Issue-focused scan	Expert groups (specialist team)	A small group of experts at the forefront of waste crime, sharing perspectives and knowledge of how new indicators of crime or behaviours might influence the waste sector in the future.	Pro: Flexible approach to obtain broad information. Con: Requires additional foresight input to obtain robust results (e.g. through stakeholder workshops, expert interviews, Delphi exercise).
Exploratory scan	Desk-top scanning (diverse, multidisciplinary team)	Desk-top research to capture early signals of waste crime, using a mix of academic and fringe sources (e.g., government departments and agencies, non-governmental organisations, international organisations, consultancies, research communities, and online and offline databases and journals).	Pro: Low resource required Con: Requires additional foresight input to obtain robust results (i.e., through stakeholder workshops, expert interviews, Delphi exercise).
	Web-assisted horizon scanning (diverse, multidisciplinary team)	Use of software (e.g., Zotero, Pearltrees, Evernote) to capture early signals of waste crime from articles and reports published on websites, including meta-data. Scanners assign sources to a pre-defined hierarchical structure (e.g., waste streams or categories) and may follow-up with expert interviews and surveys where there is limited published information.	Pro: Systematic and flexible with the capacity to obtain mass information of significant depth. Con: Resource intensive

Source: Adapted from Cranfield (2016) based on Cuhls et al. (2015), Delaney (2014), Food and Agriculture Organisation FAO (2014).

main causes and potential impacts of electronic waste. Useful questions to frame the scan are:

- Why is the signal an important indicator of waste crime?
- How is it developing?
- What evidence is available to inform us of what's causing it? What are we certain about/uncertain about?
- How is it likely to impact on the sector (e.g., regulators, industry and society)?

Issue-focused scans are particularly useful in building future narratives for policies and to help identify short-term responses (Cuhls et al. 2015, Food and Agriculture Organisation [FAO] 2014). These scans allow for better connecting emerging signals of waste crime to the political discourse around potential risks and opportunities to achieve greater traction between outputs and policy decisions (e.g., Gouldson, Morton, and Pollard 2009, Eduljee 2000).

In contrast, the workshop highlighted the need to consider macro-level issues that would require exploratory scanning to identify a wide range of signals from broad searches of the literature using keywords or factors of interest. Exploratory scans look for factors influencing crime at the macro level (i.e., across whole supply chain operations) and are useful for identifying those broad long-term issues that may influence organisational policy or strategy. They do not require a detailed specification of what to look for, but are a good way to identify new developments across the waste sector and in waste crime and consequently to identify the inherent risks and opportunities for different actors within the sector. Often exploratory scans require looking for traditional sources of information about waste crime (e.g., news bulletins about market trends, industry practice that capture familiar stories or familiar trends), but it also includes future outlooks about how waste crime is developing in other countries and, more importantly, articles that speculate about what might happen in the future. Useful questions to frame an exploratory scan are:

- Is the signal about waste crimes interesting and new?
- What is the scale and timing of the signal (or issue)?
- What does it mean for waste crime in the future, and why is it relevant and important for the sector (e.g., regulators, industry and society)?

The process helps build an understanding of the dynamic factors operating in the cross-scale or 'out of blue' domains (Table 2), although the workshop revealed a broader scan would require a high degree of stakeholder involvement to make sense of information and develop a shared perspective of the relevance and importance of signals within the waste sector, and those broad long-term issues that may influence policy. Those involved in policy and

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

regulation, for example, play a key role in interpreting how significant policy changes are likely to affect markets and influence criminal behaviours.

Both exploratory and issue-focused scans can be incorporated into a horizon scanning programme, where the balance between the two is dependent on the purpose of the scan and the information needs of the organisation. In both cases, intuition—the belief that a reported issue is likely to be strategically important in the future, even when there is insufficient evidence to prove it (UK Government Office of Science 2017)—can play an important role. Intuition can feel culturally inappropriate in an evidence-based policy context and can make it harder for scanners to understand whether an issue is interesting or distinct enough to include as a scan.

The authors' experience (AW and KG) has highlighted that establishing probing questions to define the scan field is a useful guiding step, but subsequent refinement to searches and sense-making is fundamental to ensure scanning is systematic. This should be balanced so that predefined questions about commonly accepted motivation for crime (e.g., opportunism, market dynamics and lack of threat due to lenient penal system) do not restrict the scanning team from responding to new information (e.g., change in market dynamics and regulations). Scanners should be guided by their intuition, particularly where there is a lack of evidence to refer to in interpreting why an issue is important. This is most valuable in the early stages of the scanning process. Outputs, reflecting both types of scans, should be combined into a single scan paper, a document that presents a series of short scans about sector developments that could have an impact on waste and waste crime. Adopting a standard template for the scan ensures there is a consistent format and style of writing. This was confirmed by workshop participants that suggested it should be made easy for the audience to navigate through the document and quickly find relevant information to interpret the relative importance of each scan. For instance, two different scans focusing on waste regulation and circular economy initiatives respectively should follow the same structure, making it simple to weigh their relative importance or urgency (Box 2).

BOX 2: | Typical scan

Informative title	**'Smart contracts' could improve transparency of financial transactions**
Brief background and context to the issue	'Up front' financial transactions between waste producers and service providers account for the whole life cost of waste, creating opportunities for illegal activity (e.g., default on obligations).
Describe the new or emerging development within the sector	Bitcoin, an open-source virtual currency, uses a digital protocol that relies on cryptography (the blockchain) to trade without a central authority that may be vulnerable to corruption. No central authority controls the blockchain—its operation is distributed across many computer platforms around the world. Blockchain technology can guarantee that a planned event will happen. For instance, an invoice will be automatically paid when a shipment arrives. This is done by drawing up 'smart contracts' that represent business logic written in computer code. That code is implemented on the blockchain using a programming extension called Ethereum. Smart contracts are executed when particular conditions are met.
What insights can be drawn from the scan and what does it mean for waste or waste crime?	Bitcoin transactions establish 'smart contracts' that may lead to a more reliable (secure and auditable) financial system, reducing the burden on regulators. Blockchain increases transparency in global supply chains by eliminating a vulnerable paper chain. It offers a digital footprint for each container and can reduce access to limit the risk of criminals identifying and targeting containers.
What is the potential response, challenge or future information requirements around this issue?	Financial stability (profitability) of institutions (banks) that support transactions would be challenged by blockchain. There are additional concerns about the ability of institutions to cope with the digital innovation of a blockchain transactional system; all of which questions its feasibility.
Links to information sources	Chapron 2017. https://www.nature.com/articles/545403a Murphy 2017. https://www.enterprisetimes.co.uk/2017/03/06/blockchain-help-maersk-track-supply-chain/ Gault 2016. https://techcrunch.com/2016/02/03/lets-be-honest-about-the-problems-with-blockchain-and-finance/?guccounter=1

Source: Adapted from Cranfield University (2018).

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

4.2 | Sense-Making

Horizon scanning strategies in the public sector incorporate early engagement with 'strategic thinkers' who can isolate intangible information from group discussions and transpose them to tangible facts, figures and observations, and draw out policy implications (Eastlough 2014). This raises questions about the standards and protocols for searching and updating information, and the robustness of methods used to 'meaningfully' evaluate scan data so that outputs are credible enough to inform policy decisions (Box 3, Cranfield University 2016, 2).

BOX 3: | Key design questions about the processes and protocols for evaluating the scans

- What protocols will be put in place to guide searches and ensure information collected is relevant and up to date?
- How should scans be assessed to ensure they are systematic, consistent and meaningful? How can system design ensure scans capture the 'big picture' issues (e.g., EU, UK fragmentation and geo-political tensions) and set out implications for specific sectors (e.g., regulation of waste; supply chain operations)?
- How will adjustments and updates be made (considering, for example, single significant events), so that individual scans are not rendered redundant?

The typology of 'surprises' and indicators of waste crime (Table 2) illustrates a lifecycle of change, ranging from established trends to weaker signals of change. Synthesising data on weak signals is challenging given the lack of consensus among experts where insights drawn from scan data reveals new thinking that challenges the status quo. Responding to these challenges, some horizon scanning practitioners have adopted more robust analytical methods to assess the credibility of information used to substantiate scan data (Sutherland and Woodroof 2009, Schultz 2006). Discussions at the workshop suggest there should be consideration given to the quality, reliability, and relevance of the sources used in scanning. This should include common sources such as scientific journals, government reports, NGO, international organisations and industry insights, and expert opinion, but should avoid less reliable or biased sources. Weaker signals of change are often sourced from fringe sources (e.g., news reports, blogs and

TABLE 4 | Semi-quantitative evaluation of weak signals.

Evaluation process	Implementation steps	Pros and Cons
An importance rating on a 5-point scale measured against three criteria (environmental, social and economic) is derived for each scan and then plotted against the expected timing of a development of the issue (short, medium and long-term) to indicate when an emerging threat is likely to have an impact.	For each scan: • Discuss insight(s) drawn about waste or waste crime. Debate differences of opinion about what is new, interesting/intriguing, and important (from an organisational perspective). • Assign a score that reflects the scale of the impact the issue might have on the economy, on the environment and on society; and the likelihood that the specific impact will occur in the future. Scoring uses a familiar 5-point scale (i.e., 1 low to 5 high). The overall importance score is a measure of the average impact × the likelihood of the impact (Garnett et al. 2016). • Assign a time horizon for when the impact will be seen; these can be mapped against the typology of signals (Table 2). The time horizon indicates when the impact will be seen, rather than when policy-makers and regulators need to act. • Agree the definition of the time horizon at the workshop. Time frames can be set according to policy planning cycle. Common time frames are: • 1–3 years for the foreseeable domain (Horizon 1; H1 in Figure 1). • 3–10 years for the cross-scale domain (Horizon 2; H2 in Figure 1). • more than 10 years for the 'out of blue' domain (Horizon 3; H3 in Figure 1).	Pro: Great potential to be integrated with broader risk assessment frameworks in public sector decision processes. Con: 'Value' based scoring open to bias and misrepresentation of issues, confidence about the time emergence of impact.

Sources: Cranfield University (2018), Garnett et al. (2016).

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

opinion pieces), but these sources should be assessed against criteria for credibility, relevance, and recency of information used to substantiate the scan.

Workshop participants raised concerns about taking actions on scan data when there is much uncertainty around longer-term trends. Additionally, cognitive biases (e.g., confirmation bias, anchoring bias) can influence both the interpretation of data and the decisions derived from it. Garnett et al. (2016) have highlighted the importance of adopting validation protocols to establish consistent opinion around weaker signals of change and to help evaluate the robustness of conclusions on the strategic importance of a scan, where uncertainty is high. Validation procedures include cross-checking information from multiple independent sources or against expert opinion when information is limited. Validation also provides a structured way of connecting issues to the 'political discourse' so that policy implications drawn reflect important value systems related to, for example, social, economic and environmental interests (Garnett et al. 2016).

Defining what makes an evaluation "meaningful" was a challenge discussed at the workshop. For horizon scanning to inform policy, it must go beyond identifying trends and weak signals and evaluate their potential impact on current and future policy. Establishing evaluation metrics that reflect different priorities of stakeholders in the waste industry is necessary to achieve more meaningful evaluation of scan data. Metrics should include factors such as likelihood, timing, and economic, social, and environmental impact, which provides a framework for objectively assessing how each signal or trend could influence policy. Applying the metrics can be achieved with a semi-quantitative assessment process (Table 4), conducted by a mixed group of stakeholders in a workshop, to assess the probability (i.e. likelihood of occurrence) and impact of a scan. A time horizon is also provided to indicate when an issue is likely to have an impact (e.g., short: 1–3 years, medium: 3–10 years, long: 10+ years). The time horizon should not be misconstrued as a timeline for action as an issue that creates an impact in 10 years may need action now to prevent it happening (Garnett et al. 2016).

The resulting score and assigned time horizons are approximate due to the inherent uncertainty and complex interactions. However, these ratings are indicative of importance, and help

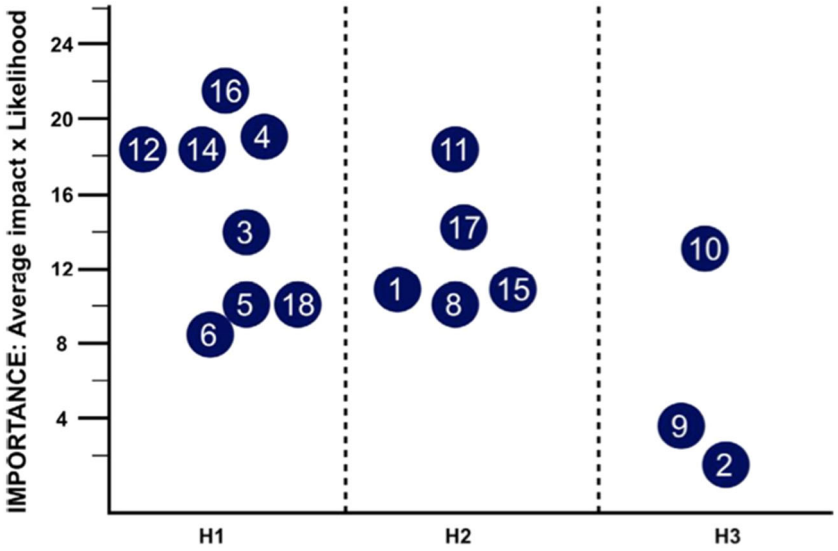


FIGURE 1 | Prioritisation of emerging issues: threat and opportunity ratings (Garnett et al. 2016).

TABLE 5 | Evaluation of cross-cutting issues.

Evaluation process	Implementation steps	Pros and cons
Cross-cutting issues are identified using a survey tool, which allows experts and policy makers to compare different issues or trends and link those that they feel are strongly connected.	• Qualitative themes, related to 2 or more issues, are drawn to define an underlying trend and narrative for a 'cross-cutting issue'. • A time horizon is then assigned for when the impact will be seen; these can be mapped against the typology of signals (Table 2). The time horizon indicates when the impact will be seen, rather than when policy-makers and regulators need to act.	Pro: Conveys information about a cross-cutting challenge or opportunity that fits to broad policy agendas. Con: 'Value' based assessment open to bias and misinterpretation of issues, and the tangible or intangible links drawn between them.

Source: Adapted from Cranfield (2016).

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

stakeholders assess intervention strategies or future research needs for the highest priority issues (Table 4, Figure 1).

Given the wide range of signals and trends captured during scanning, there is a need to introduce a tiered system for reporting based on risk (the likelihood of occurrence), scale of impact and timing. Risk prioritisation is useful in scoping and visualising the importance of emerging issues at the individual policy level (Figure 1), but for issues to be taken forward to inform policy discussion they ought to be synthesised into 'meaningful clusters' that are linked to decision-making processes (Georghiou and Cassingena Harper 2011).

Some horizon-scanning practitioners in the public sector have employed methods that assess the 'high-order' consequences and cross-cutting issues that may have an impact at the meta-policy level. Common methods combine network models and expert elicitation to explore direct and in-direct consequences of potential change (e.g., Bengston 2013, Gordon and Glenn 2009) but assessing cross-cutting issues at a meta-policy level is more common in public sector horizon scanning (Table 5).

BOX 4: | Key design questions about the visibility and utility of scan outputs

- How often should scanning outputs be produced (e.g., quarterly, bi-annually, annually)?
- What should the format be? Should scanning outputs align directly with organisational priorities and/or broader policy goals/objectives?
- What is the best format for scan outputs to ensure they are easily accessible to decision-makers and other end-users?
- How can the scan inform policy decisions and help shape the policy agenda?

4.3 | Action

Acting on horizon scanning outputs requires a champion within senior management, effective communication of outputs, timeliness in its release, and support and facilitated translation of the outputs (Delaney and Osborne 2013). There are questions around the visibility of horizon scanning in the organisation and appropriate alignment with other tools (e.g. risk assessment) to achieve visibility and support decision-making (Box 4, Cranfield 2016, 2–3).

Horizon scanning outputs can be organised according to the focus of the scan (e.g. exploratory vs. issue-focused) and in different formats but should be aligned with information needs that feed directly into planning and regulatory processes (e.g., Compliance assessments, Duty of Care Code of Practice). The workshop highlighted the need for horizon scanning outputs to be "actionable", providing clear recommendations or implications for policy change or adaptation. To encourage action, scans should emphasise the breadth of information (issues across the supply chain), depth of information (sector-specific implications) and supporting evidence to encourage fast action on emerging crime issues (Table 6).

Scans can be progressed to action through further exploration of issues in, for example, deep-dive projects that delve deeper into insights generated from a scan to establish a case for action. Scans with a high importance score (Figure 1) or of significant policy interest (e.g. cross-cutting issue) may present themselves as potential cases for deep-dive projects, outlining actionable steps that can be taken in response to identified trends.

Further exploration of scans requires working alongside the planning or delivery team to ensure intelligence from scanning informs the design of a response (Figure 2). Early engagement of the delivery team sensitises them to insights drawn from the scan, the nature of information or evidence underpinning the scan and the potential impact on operational issues. It is key, at this point, to be discerning of human elements of resilience,

TABLE 6 | Utility of scans.

Focus of the scan	Methods of assessment and data synthesis	Outputs	Policy relevance
Exploratory (broad)	Organise and analyse data to provide a high-level synthesis of broad clusters of trends (i.e. reflective of key issues/ challenges and implications for the sector).	Outputs from the scan are useful in framing policy discussions and setting the agenda for more focused scanning or other futures analysis (e.g. scenario planning).	Individual policy area
Issue-focused (narrow)	Prioritise patterns of data that occur more frequently to provide synthesis of sector-specific implications.	Outputs will identify critical issues that can be progressed to action through further exploration of issues in, for example, deep-dive projects or at departmental workshops that feed directly into planning.	Individual policy area
Cross-cutting issues (themes)	Prioritise patterns of data that occur more frequently and assess cross-cutting issues to further expand from sector-specific to sector-wide implications, relevant to multiple policy areas.	Outputs will identify critical issues that can be progressed to action through further exploration of issues in, for example, deep-dive projects or at interagency workshops that feed directly into planning, investment or regulatory reviews.	Meta-policy analyses

Source: Cranfield University (2016, 2018).

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

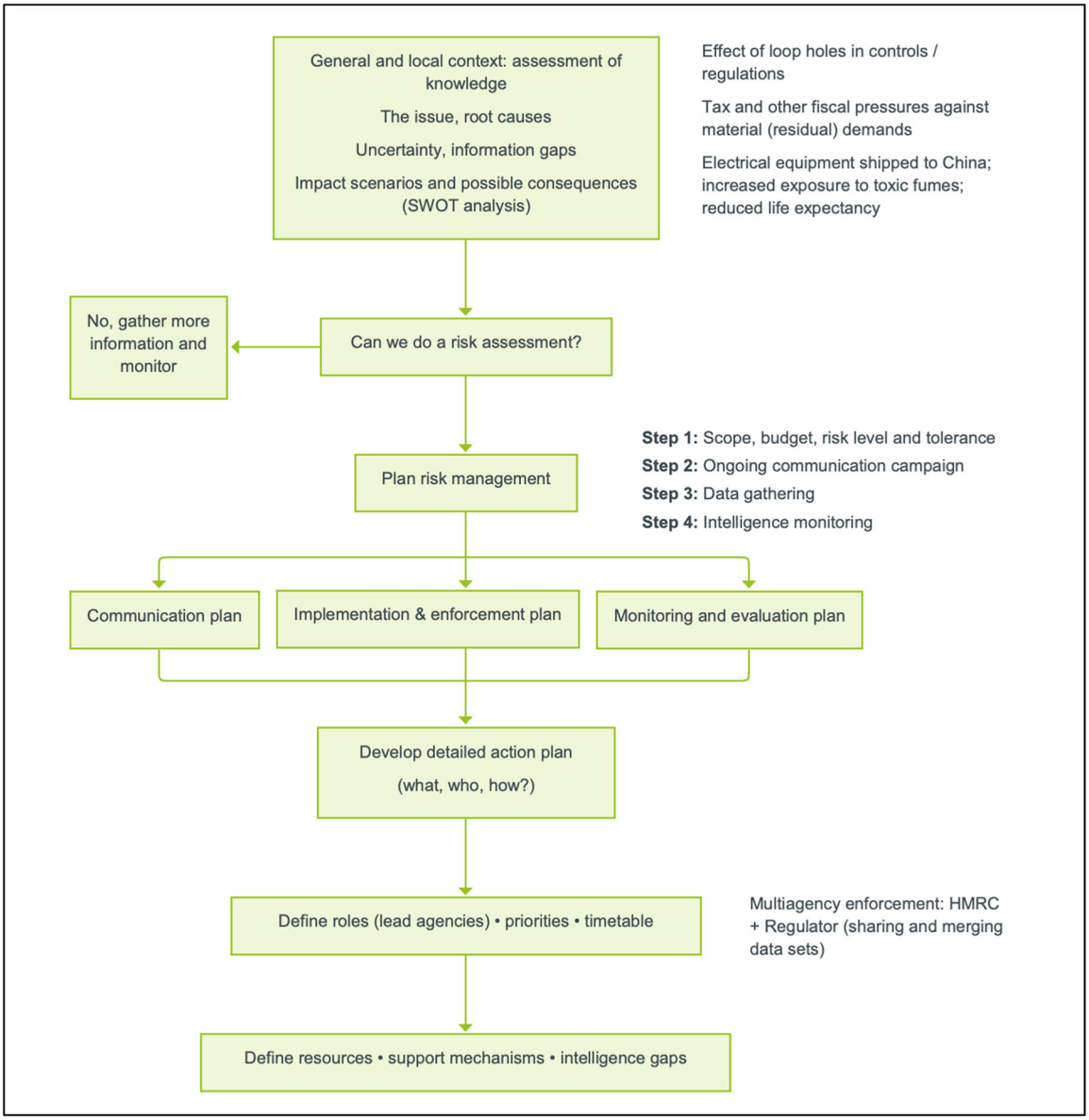


FIGURE 2 | Project plan flow chart (Cranfield University 2018, 51).

particularly the often overlooked cognitive and contextual properties that support the building of resilience at an organisational level (Giffoni et al. 2022). This undertaking may require involving industry stakeholders to look at practices from other parts of the world that have proven successful in tackling waste crime or novel practices in other industries that can be introduced to manage waste crime.

Further research around emerging issues (e.g., deep-dive projects) can help develop a rationale for action and allow the delivery team to debate the benefits of different options, the trade-offs and the new ways forward. Deep dives help to develop responses that are practical and implementable, but are pursued for different purposes (Cranfield University 2018):

- Identify potential responses to emerging issues or challenges that are familiar or already on the horizon (*foreseeable domain*); for example, insights around new waste legislation introduced abroad (e.g., China's National Sword legislation). In this case, the deep-dive focuses on analysing the gaps in knowledge and identifying the resources, skills and capacity needed to effect appropriate actions.
- Develop a better understanding of emerging issues or challenges that have the potential to materialise in the near future if current trends continue (*cross-scale domain*); that is, insights around circular economy innovations that may transform how the industry operates. In this case, the deep dive focuses on developing a better understanding of the 'root' of an emerging issue and the potential opportunities or pressure points for the future, and on developing a framework for monitoring and adapting to change.
- Re-think the case for action, where the shape of the waste and waste crime landscape moving forward remains unclear (*'out-of-blue' domain*); that is, insights around

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

complex supply chain risks and a changing regulatory environment that present new opportunities for criminals. In this case, the deep dive focuses on analysing the extent to which the knowledge gathered may redefine or reduce the intensity of problems and change the case for intervention and the ownership of policy issues.

Carrying out an in-depth analysis on all issues captured in the scan is not practical so the aim should be to identify critical issues and opportunities for individual stakeholders or cross-cutting policy issues that require a coordinated strategic response.

Acknowledgments

This research was commissioned and funded by the Scottish Environmental Protection Agency as part of the Smarter Regulation of Waste in Europe, LIFE SMART Waste project, (LIFE13 ENV-UK-000549). The authors thank the experts from the Scottish Environmental Protection Agency, numerous other government agencies, environmental regulators, law enforcement, waste management companies and waste industry professional bodies for their valuable contribution. The views expressed in this paper are those of the authors only. The content of the paper does not represent UK Government policy nor the policy or position of the Scottish Environmental Protection Agency.

Data Availability Statement

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Endnotes

[1]The nine sectors are listed as "transport, the used-car industry, horeca (a term commonly used in the Netherlands and Belgium to collectively describe the hotel, restaurant, and catering/café industries i.e., the hospitality sector), legalised gambling, construction, waste disposal, insurance, wildlife and nuclear materials trade." (Beken 2004; 506–507).

[2]Weak signals are defined as past or current developments (i.e., emerging issues) with ambiguous interpretations of their origin, meaning and/or implications. Often these are unclear observable trends or patterns that warn us about the possibility of future events (iKnow 2016).

[3]Here the word 'system' refers to the fact the waste management sector could be viewed as a complex system. In doing so, it allows the consideration of multiple factors, their interactions and their incorporation into waste management dynamic models. System dynamics "is particularly suited to the simulation of complex systems such as waste management systems. It is capable of dealing with assumptions about system structures in a stringent fashion, and particularly of monitoring the effects of changes in subsystems and their relations" (Karavezyris, Timpe, and Marzi 2002, 150).

[4]Weak signals are defined as past or current developments (i.e. emerging threats) with ambiguous interpretations of their origin, meaning and/or implications. Often these are unclear observable trends or patterns that warn us about the possibility of future events (iKnow 201610).

[5]The joint Unit of Waste Crime (JUWC) comprises eight UK government organisations including the Environment Agency, Her Majesty Revenue and Customs (HMRC), The National Crime Agency, and various police units such as the Serious Fraud Office.

References

Almer, C., and T. Goeschl. 2015. "The Sopranos Redux: The Empirical Economics of Waste Crime." *Regional Studies* 49, no. 11: 1908–1921.

Beken, T. V. 2004. "Risky Business: A Risk-Based Methodology to Measure Organized Crime." *Crime, Law and Social Change* 41, no. 5: 471–516.

Bengston, D. 2013. "Horizon Scanning for Environmental Foresight: A Review of Issues and Approaches." In *General Technical Report NRS-121*, 20. Newtown Square, PA: U.S Department of Agriculture, Forest Service, Northern Research Station.

Bevan, J. 2022. "Crackdown on Waste Crime: Time To Stop Trashing our Future." Environment Agency Chief Executive Sir James Bevan's Speech on Waste Crime. Let's Recycle and Environmental Services Association Event on April 12, 2022. https://www.gov.uk/government/speeches/crackdown-on-waste-crime-time-to-stop-trashing-our-future.

Bowden, R. A. 2004. "Building Confidence in Geological Models." *Geological Society, London, Special Publications* 239: 157–173. https://doi.org/10.1144/GSL.SP.2004.239.01.11.

Brooks, H. 1986. "The Typology of Surprises In Technology, Institutions, and Development." In *Sustainable Development of the Biosphere*, edited by W. C. Clark and R. E. Munn, 2325–2348. Cambridge, UK: Cambridge University Press.

Brown, M., S. Taylor, P. Jones, J. Hudson, A. Bapasola, and A. Henry. 2017. "Rethinking Waste Crime." Eunomia. https://www.eunomia.co.uk/reports-tools/rethinking-waste-crime/.

Carter, D. L. 2021. "Law Enforcement Intelligence: A Guide for State, Local and Tribal Law Enforcement Agencies (3rd Edition)." Justice Information Sharing. https://bja.ojp.gov/library/publications/law-enforcement-intelligence-guide-state-local-and-tribal-law-enforcement.

Carter, D. L., and J. G. Carter. 2009. "Intelligence-Led Policing: Conceptual and Functional Considerations for Public Policy." *Criminal Justice Policy Review* 20, no. 3: 310–325. https://doi.org/10.1177/0887403408327381.

Cuhls, K., L. Erdmann, and P. Warnke, et al. 2015. "Models of Horizon Scanning. How to Integrate Horizon Scanning into European Research and Innovation Policies." Fraunhofer Competence Centre for Foresight. https://www.researchgate.net/publication/303403699_Models_of_Horizon_Scanning_-_How_to_integrate_Horizon_Scanning_into_European_Research_and_Innovation_Policies#fullTextFileContent.

Cope, N. 2004. "Intelligence led Policing or Policing led Intelligence? Integrating Volume Crime Analysis Into Policing." *British Journal of Criminology* 44: 188–203.

Cranfield University. 2016. "EU Life Smart Waste Project." Phase 1 Report: Review of Financial Tools in Relation to Waste Crime. Internal SEPA Report, May 18, 2016.

Cranfield University. 2018. "Smarter Regulation of Waste in Europe." LIFE SMART Waste Project. LIFE13 ENV-UK-000549. Action B4: Horizon Scanning Toolkit. https://www.sepa.org.uk/media/367059/lsw-b4-horizon-scanning-toolkit-v10.pdf.

D'Amato, A., M. Mazzanti, F. Nicolli, and M. Zoli. 2018. "Illegal Waste Disposal: Enforcement Actions and Decentralized Environmental Policy." *Socio-Economic Planning Sciences* 64: 56–65.

Dalton, H. 2002. *Defra's Horizon Scanning Strategy for Science*. London: Department for Environment, Food and Rural Affairs (Defra). http://webarchive.nationalarchives.gov.uk/20071022164356/horizonscanning.defra.gov.uk/.

Day, G. S., and P. J. Schoemaker. 2005. "Scanning the Periphery." *Harvard Business Review* 83, no. 11: 135–140. https://pubmed.ncbi.nlm.nih.gov/16299966/.

Delaney, K. 2014. "Innovation Tool Kit: A Practical Guide: Introduction to Horizon Scanning in the Public Sector." APO. http://apo.org.au/files/Resource/publicsectorinnovationtoolkithorizonscanningmodule2014.pdf.

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Delaney, K., and L. Osborne. 2013. "Public Sector Horizon Scanning – Stocktake of the Australasian Joint Agencies Scanning Network." *Journal of Futures Studies* 17: 55–70.

Eastlough, N. 2014. "Future-Proofing the State: Mapping Risks, Responding to Crises and Building Resilience." In *Improving Resilience Through Environmental Scanning in Western Australia*, edited by J. Boston, Canberra: The Australian National University. http://press-files.anu.edu.au/downloads/press/p283571/pdf/12.-Improving-Resilience-through-Environmental-Scanning-in-Western-Australia.pdf.

Eduljee, G. H. 2000. "Trends in Risk Assessment and Risk Management." *Science of The Total Environment* 249: 13–23.

Environment Agency UK 2017. "Evidence: Waste Crime Interventions and Evaluation Project." https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/662841/Waste_crime_interventions_and_evaluation_-_report.pdf.

Environment Agency UK 2021. "National Waste Crime Survey Report 2021 - Findings and Analysis." Chief Scientist's Group Report. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1023187/National_waste_crime_survey_report_2021_-_report.pdf.

Environment and Energy 2023. "A Criminal Waste–What Is Going On With Waste Crime?" CIWM, Legislation and Regulation Circular for Resource and Waste Professionals. https://www.circularonline.co.uk/features/a-criminal-waste-what-is-going-on-with-waste-crime/.

European Commission 2016. "Science for Environmental Policy Future Brief: Identifying Emerging Risks for Environmental Policies." Issues 13. https://www.mosquitoalert.com/wp-content/uploads/2017/02/emerging_environmental_risks_early_warnings_FB12_en.pdf.

European Commission 2024. "Training package on Combatting Waste Crime - Module 2: Combatting Waste Crime Through Environmental Criminal Law." https://www.era-comm.eu/combatting_waste_crime/module_2/module_2_2.html.

European Food Safety Authority (EFSA), T. Donohoe, K. Garnett, A. O. Lansink, A. Afonso, and H. Noteborn. 2018. "Scientific Report on the Emerging Risks Identification on Food and Feed." *EFSA Journal* 16, no. 7: 5359. https://doi.org/10.2903/j.efsa.2018.5359.

Folke, C., L. Pritchard, Jr., F. Berkes, J. Colding, and U. Svedin. 2007. "The Problem of Fit between Ecosystems and Institutions: Ten Years Later." *Ecology and Society* 12, no. 1: art30.

Food and Agriculture Organisation (FAO). 2014. "Horizon Scanning and Foresight: An Overview of Approaches and Possible Application in Food Safety." Background Paper 2: FAO Early Warning/Rapid Alert and Horizon Scanning, Food Safety Technical Workshop, Rome, October 22–25, 2013. https://www.fao.org/3/i4061e/i4061e.pdf.

Garnett, K., F. A. Lickorish, S. A. Rocks, G. Prpich, A. A. Rathe, and S. J. T. Pollard. 2016. "Integrating Horizon Scanning and Strategic Risk Prioritisation Using a Weight of Evidence Framework to Inform Policy Decisions." *Science of the Total Environment* 560–561: 82–91. https://doi.org/10.1016/j.scitotenv.2016.04.040.

Georghiou, L., and J. Cassingena Harper. 2011. "From Priority-Setting to Articulation of Demand: Foresight for Research and Innovation Policy and Strategy." *Futures* 43: 243–251.

Gibbs, C., E. F. McGarrell, and B. Sullivan. 2015. "Intelligence-Led Policing and Transnational Environmental Crime: A Process Evaluation." *European Journal of Criminology* 12, no. 2: 242–259. https://doi.org/10.1177/1477370815571947.

Giffoni, E., S. Jude, H. M. Smith, and S. J. T. Pollard. 2022. "Real-Life Resilience: Exploring the Organisational Environment of International Water Utilities." *Utilities Policy* 79: 101394.

Gordon, T. J., and J. C. Glenn. 2009. "Environmental Scanning." In *Futures Research Methodology—Version 3.0*, edited by J. C. Glenn and T. J. Gordon, Washington, DC: The Millennium Project. https://www.millennium-project.org/publications-2/futures-research-methodology-version-3-0/

Gouldson, A., A. Morton, and S. J. T. Pollard. 2009. "Better Environmental Regulation – Contributions from Risk-Based Decision-Making." *Science of The Total Environment* 407: 5283–5288.

Gunderson, L. 1999. "Resilience, Flexibility and Adaptive Management—Antidotes for Spurious Certitude?" *Conservation Ecology* 3, no. 1: art7.

Heckenberg, D., and R. White. 2011. "Key Vulnerabilities and Limitations in the Management of Hazardous Waste and its Disposal: A Checklist Assessment Tool." *Journal of Environmental Protection* 2: 1257–1263. https://doi.org/10.4236/jep.2011.29145.

iKnow. 2016. "What Is a Weak Signal?" iKnow: The Innovation, Foresight and Horizon Scanning System. EU FP7 Project. http://wiwe.iknowfutures.eu/what-is-a-weak-signal/.

Institute of Risk Management (IRM). 2018. "Horizon Scanning: A Practitioner's Guide." https://pure.roehampton.ac.uk/ws/portalfiles/portal/1155531/Horizon_scanning_final2.pdf.

Karavezyris, V., K. P. Timpe, and R. Marzi. 2002. "Application of System Dynamics and Fuzzy Logic to Forecasting of Municipal Solid Waste." *Mathematics and Computers in Simulation* 60, no. 3–5: 149–158.

Luís, A., K. Garnett, S. J. T. Pollard, F. Lickorish, S. Jude, and P. Leinster. 2021. "Fusing Strategic Risk and Futures Methods to Inform Long-Term Strategic Planning: Case of Water Utilities." *Environment Systems and Decisions* 41, no. 4: 523–540. https://doi.org/10.1007/s10669-021-09815-1.

NATO. 2002. "Press Conference by US Secretary of Defence Donald Rumsfeld." http://www.nato.int/docu/speech/2002/s020606g.htm.

Palomino, M. A., T. Taylor, G. McBride, H. Mortimer, R. Owen, and M. Depledge. 2013. "Optimising Web-Based Information Retrieval Methods for Horizon Scanning Using Relevance Feedback." *Federated Conference on Computer Science and Information Systems (FedCSIS)* 2013: 1139–1146. https://fedcsis.org/2013/node/1.html.

Perry, W., B. McInnis, and C. Price. 2013. "Predictive Policing: The Role of Crime Forecasting In Law Enforcement Operations." RAND Safety and Justice Programme. http://www.rand.org/content/dam/rand/pubs/research_reports/RR200/RR233/RAND_RR233.pdf.

van Rij, V. 2010. "Joint Horizon Scanning: Identifying Common Strategic Choices and Questions for Knowledge." *Science and Public Policy* 37: 7–18.

Rucevska, I., C. Nellemann, N. Isarin, et al. 2015. *"Waste Crime – Waste Risks: Gaps in Meeting the Global Waste Challenge. A UNEP Rapid Response Assessment*." Nairobi and Arendal: United Nations Environment Programme and GRID - Arendal. https://europa.eu/capacity4dev/file/25575/download?token=WAWKTk7p.

Schiller, F., and G. Prpich. 2014. "Learning to Organise Risk Management in Organisations: What Future for Enterprise Risk Management?" *Journal of Risk Research* 17, no. 8: 999–1017. https://doi.org/10.1080/13669877.2013.841725.

Schultz, W. L. 2006. "The Cultural Contradictions of Managing Change: Using Horizon Scanning in an Evidence-Based Policy Context." *Foresight* 8: 3–12.

Sutherland, W. J., and H. J. Woodroof. 2009. "The Need for Environmental Horizon Scanning." *Trends in Ecology & Evolution* 24: 523–527.

Suvantola, L., and T. Kankaanranta. 2018. "Broadening the Toolbox for the Prevention of Illegal Waste Trafficking, to Address Emerging Threats." *Environmental Policy and Law* 48, no. 1: 64–74.

UK Government Office of Science. 2017. The Futures Toolkit. Tools for Futures Thinking and Foresight Across UK Government. UK Government Office for Science. https://assets.publishing.service.gov.uk/media/5a821fdee5274a2e8ab579ef/futures-toolkit-edition-1.pdf.

Wilkinson, E., and L. Cleary. 2021. "If You Can't Be Secure, Be Resilient." In *Security in the 21st Century: Its Governance and Management*, edited by C. R. Darby, New York: Routledge.

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Appendix 1

Workshop Agenda

1000 Introduction

1015 Thinking about the future

1040 Outputs of phase 1 literature review (interactive discussion)

1130 Breakout group discussion

Top level design characteristics of the horizon scanning toolkit

1230 Plenary review and discussion

1300 Lunch

1330 Measuring the value of the toolkit

1345 Breakout group discussion

Designing the end-user experience

1445 Plenary review and discussion

1515 Break

1530 Final plenary discussion and next steps

1600 Close

Appendix 2

Literature review: Summary of Horizon Scanning Design Methodologies

Overview

Design parameters	Description	
Context	Value and sustainability of scanning activity	• Information needs • Resource availability
Capability	Ability to interpret and react to change	• Scan team • Scan approach • Data assessment & synthesis
Impact	Outcome and value	• Communication and influence • Visibility

Context

Value and sustainability of scanning activity	Design considerations
Information needs Resource availability	• Broad scan of relevant sectors/indicators • Legislative/regulatory environment • Nature of waste & resources • Waste trade & markets • Supply chain operations • Issue-focused scan of relevant sectors/indicators • WEEE regulations • WEEE trade & markets • eWaste economics • Health and safety practice • Regulatory scan • Competition & innovation • Supply chain operations

(Continues)

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Value and sustainability of scanning activity	Design considerations
	• Enforcement, monitoring & control • Balance between different functions • Time horizon for the scan function (e.g., 5, 10+ years)

Capability

Ability to interpret and react to change	Design considerations
Scan team	• In-house capability and resources • Need for inter-departmental or inter-agency collaborations • Measures that ensure scanners (and other users) understand and apply the tool appropriately
Scan approach	• Appropriateness of the tool & ease of use (e.g., automated, semi-automated) • Need for inter-departmental or inter-agency collaborations • Measures that ensure scanners (and other users) understand and apply the tool appropriately
Data analysis and synthesis	• Search protocols and selection criteria to guide scanning • Process set for analysis and interpretation of scans (systematic, consistent and meaningful) • Adjustments and updates of the scans (process and frequency)

Impact

Outcome and value	Design considerations
Communication and influence	• No. and frequency of outputs (quarterly and bi-weekly) • Format of scan, alignment with policy/strategy goals/objectives • Accessibility and utility in decision-making
Visibility	• Scanning champion to drive the process, make outputs visible • Integration of scanning outputs with other sources of evidence (e.g., risk analysis)

25735152, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ffo2.201 by Test, Wiley Online Library on [12/11/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License



https://dspace.org/

Using horizon scanning to build policy resilience: case of waste crime

Garnett, Kenisha; Wilson, Alister; Wilkinson, Edith

2024-04
Wiley
https://doi.org/10.1002/ffo2.201
Garnett K, Wilson A, Wilkinson E. (2025) Using horizon scanning to build policy resilience: case of waste crime. Futures & Foresight Science, Volume 7, Issue 1, April 2025, Article number e201

Downloaded from a DSpace repository. https://dspace.org/