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When forecasting and foresight meet data and innovation: toward a taxonomy of anticipatory methods for migration policy

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Abstract

The various global refugee and migration events of the last few years underscore the need for advancing anticipatory strategies in migration policy. The struggle to manage large inflows (or outflows) highlights the demand for proactive measures based on a sense of the future. Anticipatory methods, ranging from predictive models to foresight techniques, emerge as valuable tools for policymakers. These methods, now bolstered by advancements in technology and leveraging nontraditional data sources, can offer a pathway to develop more precise, responsive, and forward-thinking policies. This paper seeks to map out the rapidly evolving domain of anticipatory methods in the realm of migration policy, capturing the trend toward integrating quantitative and qualitative methodologies and harnessing novel tools and data. It introduces a new taxonomy designed to organize these methods into three core categories: Experience-based, Exploration-based, and Expertise-based. This classification aims to guide policymakers in selecting the most suitable methods for specific contexts or questions, thereby enhancing migration policies.

Policy Significance Statement

This research holds policy significance by addressing the complexities of contemporary migration patterns. As global migration becomes increasingly multifaceted, decision-makers face unprecedented challenges. The study sheds light on the evolving landscape of anticipatory methods, providing insights that can enable decision-makers to transition from reactive to proactive migration policies. By proposing a new taxonomy and investigating the timeframe and maturity of selected methods, this research offers a framework for decision-makers to navigate the intricate forces shaping human migration.

1. Introduction

The unprecedented increase in human mobility across the globe has necessitated the advancement of anticipatory methods in the study of migration patterns (Buhaug, 2023). These methods, encompassing

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both quantitative analyses and scenario-based projections, aim to provide policymakers with the tools to foresee and effectively respond to future mobility trends. However, the academic community has highlighted a significant challenge in this endeavor, pointing out that migration data is often "largely insufficient and too complex" for straightforward analysis (Tjaden et al., 2018). Despite these limitations, there has been a notable surge in interest among policy circles within the European Union and Organisation for Economic Co-operation and Development (OECD) countries toward leveraging forecasting tools for examining future migration flows using anticipatory methods (De Haas et al., 2010; Friedrich-Ebert-Stiftung et al., 2017).

Recent studies reveal an increasing reliance on "big data" as a means to augment traditional migration data sources (Tjaden, 2021; Wanner, 2021; Ahmad Yar and Bircan, 2023; Drouhot et al., 2023). This approach introduces its own set of ethical and empirical challenges that must be navigated carefully (Bosco et al., 2022). The growing dependency on forecasting methods for policymaking underscores the need for a deeper understanding of the anticipatory methods employed in migration policy. These methods provide a framework to manage complex migration trends and shift from reactive to proactive policymaking.

However, the adoption of anticipatory methods in policymaking is often met with uncertainty regarding the selection of the most appropriate techniques. This uncertainty is compounded by the rapid pace of innovation in this field, including the exploration of nontraditional data sources. Yet, the lack of a detailed taxonomy for anticipatory methods leaves researchers and policymakers without clear guidance on choosing the best methods and data sources for their needs.

Addressing this gap, our paper sets out to map the current landscape of anticipatory methods utilized in migration policy. This examination reflects the ongoing shifts within the field, marked by a blend of quantitative and qualitative approaches and the incorporation of novel tools and data sources. Through this analysis, we aim to propose a taxonomy that captures these evolving trends, thereby providing a guide for more effective decision-making in this complex and dynamic area. The proposed taxonomy does not hope to clarify the array of available anticipatory methods but also facilitates their application in designing robust, forward-looking migration policies. Ultimately, the paper aims to contribute to the broader effort of equipping governments and international organizations with the necessary tools to navigate the challenges of contemporary migration with informed, anticipatory strategies.

2. An overview of anticipatory methods for migration: potential benefits and challenges

Anticipatory methods may enhance migration policies, offering benefits like evidence-based decision-making. These methods may support policy evaluation, adaptation, resource allocation, root cause identification, and humanitarian aid facilitation. Acknowledging these merits, the second half of this section recognizes the associated challenges, encompassing conceptual concerns (e.g., fossilization, unfalsifiability, and preemptive intervention legitimacy) and practical issues (e.g., interdisciplinary collaboration, data quality, availability, capacity building, and stakeholder engagement).

While anticipatory methods do not claim to eliminate uncertainty entirely (Bijak and Czaika, 2020), they seem to offer a means to develop more precise, adaptable, and forward-thinking policies. In an era where the movement of people continues to evolve, anticipation can offer a multitude of potential benefits, including enabling evidence-based policy development, facilitating policy evaluation and adaptation, supporting strategic resource allocation, identifying root causes, mitigating immediate risks, and fostering international cooperation and governance. Below, we delve into each of the aforementioned reasons, exploring how anticipatory methods can contribute to more informed, resilient, and proactive migration policies.

First, anticipatory methods can enable more proactive policy development in the early stages of the policy cycle (Howlett et al., 2015). For instance, the Migration Preparedness and Crisis Management Mechanism (Blueprint) Network (European Commission, 2020b) is an operational framework for monitoring and anticipating migration flows and migration situations, building resilience, and organizing

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a coordinated response to migration crises. The network seeks to develop an early warning and forecasting system to anticipate migration flows and trends, being complementary to other EU crisis management mechanisms, such as the EU Civil Protection Mechanism (European Commission, 2023) and the Integrated Political Crisis Response (IPCR) (European Commission, 2020a). The system uses a range of data sources, including satellite imagery and social media, to identify potential migration hotspots and anticipate future migration flows, thereby aiming to enable enhanced preparedness, proactive governance, and timely responses.

Secondly, anticipatory methods can aid policy evaluation and adaptation. In an uncertain world, the ability to adapt is crucial. Anticipatory mechanisms can set the stage for policies that are more flexible and adaptable, designed with the understanding that conditions may change. For instance, anticipatory methods developing counterfactual inference using past time series data with plausible migration policy scenarios can be used to analyze the effect of search-and-rescue missions (Rodríguez Sánchez et al., 2023) on the number of crossing attempts of migrants across the Mediterranean, allowing policymakers to evaluate existing policies and adapt them based on their effectiveness.

Further, through the analysis of migration data and by anticipating future migration patterns, policymakers can pre-position resources, establish contingency plans, and implement proactive measures to respond effectively. This includes allocating resources such as housing, healthcare (Alarcon, 2022), education, and social services in a targeted and efficient manner, ensuring efficient and equitable distribution of support. For instance, the Anticipatory Pillar of the Disaster Response Emergency Fund (DREF) is an initiative by the International Federation of Red Cross and Red Crescent Societies (IFRC) that enables Red Cross and Red Crescent Societies to take early action before disasters strike (IFRC, 2022a). The Anticipatory Pillar uses a forecast-based financing approach based on meteorological forecasts and risk analysis that helps direct funds automatically, when predefined forecast thresholds or "triggers" are met.

It then seems important to note how, by analyzing data and projecting future scenarios, anticipatory methods can help identify underlying factors that drive migration. Indeed, through the analysis of both historical and present data, decision-makers can evaluate a variety of drivers and scenarios, including poverty and unemployment rates, access to education and healthcare, as well as conflict and environmental degradation rates (Czaika and Reinprecht, 2020). Initiatives like the one undertaken by the UNHCR Innovation Service (2022) employ foresight methodology including signal mapping, causal layered analysis, and scenario archetypes to identify overlooked aspects of the refugee experience and the components of a given crisis to surface new root-cause insights. When policymakers and organizations identify the root causes of migration through data analysis and scenario projection, they can develop comprehensive strategies that focus on long-term solutions and ultimately promote sustainable development.

Finally, anticipatory methods can facilitate the establishment of early warning systems (World Health Organization, 2023) and coordinated response mechanisms that span across multiple countries, thus promoting humanitarian aid through cross-border cooperation, harmonization of migration policies, and the development of common goals and standards. For instance, the Famine Early Warning System Network is an initiative that uses anticipatory methods to provide projections of food security outcomes for the coming eight months. The FEWS NET analysts adopt a standardized eight-step process to assess the current food security situation in areas of concern, make assumptions about the future, and consider how those assumptions might affect food and income sources for poor households. More specifically, the initiative uses remote sensing satellite imagery to monitor and forecast climatic conditions in the world's most food-insecure regions (FEWS NET, n.d) and analyzes drivers of acute food insecurity, including economic, social, natural, and political factors.

It is important to note that despite the uptick in human mobility and technological advances to gather and (re)use data on and from migration patterns, there still exists a notable challenge in effectively foreseeing, anticipating, and preparing for large movements of migrants, creating bureaucratic burden, inefficient resource use, and reactive support for people on the move.

The challenges associated with predictions and anticipatory methods in the context of migration policy and governance are multifaceted. All in all, it seems possible to divide them into two main categories,

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namely (a) the conceptual challenges of adopting anticipatory techniques, which span from algorithmic bias to uncertainty, from the legitimacy of preemptive intervention to group privacy, from self-fulfilling prophecies (Matsumi and Solove, 2023) to the politicization of predictions, and (b) the implementation challenges of mitigating those challenges, successfully employing and executing the methods, including issues of collaboration, data availability and quality, capacity building, and stakeholders engagement.

One key conceptual challenge is the issue of fossilization, whereby algorithmic predictions reinforce patterns (Benjamin, 2023) in data about the past, potentially perpetuating preexisting inequality (Noble, 2018). This is due to inherent biases[1] in the data collected, such as those arising from the overrepresentation or underrepresentation of certain groups or regions, which can skew predictive outcomes. In turn, this can lead to the entrenchment of existing marginalizing patterns in the context of migration, and hinder efforts to address systemic issues. One example is the use of predictive algorithms in immigration and border control. Predictive algorithms use historical data to make predictions about future migration patterns and trends. However, if the historical data is biased or incomplete, the algorithm may perpetuate preexisting biases and inequalities, leading to the entrenchment of existing marginalizing patterns in the context of migration. For example, if an algorithm is trained on data that disproportionately represents certain groups or regions, according to Smith et al. (2023) it may be more likely to identify those groups or regions as high-risk for migration, even if the actual risk is lower. This can lead to discriminatory policies that unfairly target certain groups or regions, and hinder efforts to address systemic issues related to migration.

Another challenge is the uncertainty problem, where the accuracy level of anticipations can vary significantly (Bijak and Czaika, 2020), mainly due to the data that is available and its different conceptualizations, shock events, unpredictable changes to migration drivers, and large variations in how migrants respond to these changes. For instance, Fernández-Huertas Moraga and López Molina (2018) use a gravity type model to predict bilateral migration flows up to 2100. However, the predictions showcase large variations in projections beyond 2050, emphasizing the challenge posed by the inherent uncertainty in anticipatory methods.

Additionally, it seems worth considering the preemptive intervention problem, where predictions about future migration events remain unverifiable until those events actually occur, and decisions or interventions based on those predictions may result illegitimate (Murphy, 2005). Sustain (2021) discusses the complications arising from "precautionary principles" in policymaking, particularly how acting on predictions can lead to significant ethical dilemmas and accountability issues when those predictions may not materialize. In the context of anticipating migration for policymaking, this raises important concerns about accountability and transparency in decision-making processes, especially when using machine learning algorithms. Indeed, Robinson and Dilkina (2018) propose that techniques such as machine learning can be used to model migration flows, yet the models and variables analyzed therein can be opaque, and the decisions made based on them can be hard to trace back, verify, and account for (Burrell, 2016; Pasquale, 2015).

Using data-based systems to anticipate migratory patterns and design policy interventions also presents the challenge of preserving group privacy. While there are an ever-growing number of international policies and frameworks addressing individual data protection and privacy, those hardly take into account people's right to privacy as a group. The idea that groups have a right to privacy in society is based on the notion that certain groups may be easily identified and targeted (Floridi, 2014), despite the relative anonymity of the individuals making up that group (Mittelstadt, 2017). For instance, the potential of using digital advertising trace data from Facebook's Marketing API to estimate daily subnational population sizes is ever more recognized (Leasure et al., 2023). While the data can be anonymized and aggregated to preserve individual

[1] In this paper, when discussing bias in the context of predictive algorithms and migration data, we refer to algorithmic bias and data bias. These are distinct from the statistical terms "accuracy" and "precision." Algorithmic and data bias occur when an algorithm produces systematically prejudiced results due to erroneous assumptions in the model or biases in the data input. Accuracy and precision describe a model's performance characteristics rather than its inherent flaws or biases. A model can be biased but still precise if it consistently produces similar erroneous outcomes. Conversely, a model could be unbiased but imprecise if its predictions are correct on average but widely varied.

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privacy, it is important to highlight that protecting the privacy of each group member will not, in fact, protect the privacy of the group (Cohen, 2012). This emphasizes the pressing necessity for a more comprehensive assessment of responsible data practices, one that includes group privacy, especially when utilizing such data for policymaking decisions that impact entire groups, so as to ultimately ensure the privacy and dignity of all individuals within these populations.

Further, it is important to note how algorithmic predictions have the capacity to shape the future (Cohen, 2012) they aim to anticipate, leading to a self-fulfilling prophecy dynamic that can ultimately lead to inertia in the system (Bouderbane, 2020). This feedback loop between predictions and migration behaviors can produce unintended outcomes and indirectly perpetuate unwanted patterns. Given the nascent development and use of these tools, our repository does not include any explicit real-world examples of this challenge. However, it seems worth acknowledging the potential for this issue to arise as they mature.

One significant additional challenge can arise when predictions about migration are politicized and used for political purposes. Instead of employing these predictions to inform evidence-based policymaking and address migration challenges, political actors may manipulate and exploit them to serve their own agendas. It is thus important to develop auditing and monitoring mechanisms that ensure that the anticipation insights are not politicized. This requires ongoing scrutiny, evaluation, and refinement of the methodologies used in generating predictions. Given the nascent development and use of these tools, our repository does not include any explicit real-world examples of this challenge. However, again, it seems worth acknowledging the potential for this issue to arise as they mature.

Finally, false positives and false negatives are important considerations within the realm of anticipatory methods, particularly in the context of migration policy. False positives occur when predictions are made for events or risks that do not come to pass, potentially leading to unwarranted actions or resource allocation. Conversely, false negatives arise when actual migration events or risks go undetected, resulting in inadequate preparedness or support. Ongoing model refinement, data quality enhancement, and feedback mechanisms are integral to reducing these errors. Furthermore, ethical and legal safeguards, including transparency, accountability, and mechanisms for challenge and redress, are essential for ensuring the responsible and equitable use of algorithmic prediction in the field of migration policy. As for the Self-fulfilling Prophecies and the Politicization of Algorithmic Predictions challenges, our repository does not include any explicit real-world examples of the politicization of algorithmic predictions.

As far as implementation challenges go, firstly, effectively utilizing anticipatory methods often requires collaboration across multiple disciplines and sectors. Integrating expertise from fields such as data science, statistics, social sciences, migration studies, and policymaking is essential but can be challenging due to differences in terminology, methodologies, and approaches. Aiming to stimulate discussions, Szczepanikova and Van Criekinge (2018) delineate four possible future migration scenarios toward 2030, providing a set of interactive tools that stimulate forward-looking and strategic discussions and that can be used to involve various actors that shape migration policymaking and research in a collaborative and interdisciplinary way.

Secondly, anticipatory methods heavily depend on data, and their effectiveness is contingent upon the availability and quality of relevant data sources. Obtaining accurate, timely, and comprehensive data can be a challenge, particularly when dealing with complex and dynamic phenomena such as migration. Gaps and inconsistencies in data can significantly limit the accuracy and reliability of predictive models. The US National Intelligence Council Global Trends 2040 report (2021) methodology uses their own previous editions and extensive research and consultations to identify future trends. Faced with the lack of data availability, they are generating the data themselves, ensuring its quality, to envision possible futures. In parallel, the production and nature of migration statistics are evolving, with state bureaucracies no longer serving as the primary sources of migration data. Today, a multitude of unofficial data sources and collaborative processes generate migration and mobility data as the result of both commercial and governmental operations (Meissner and Taylor, 2024). These data sources often come from commercial entities primarily focused on telecommunications and social media, which originally did not intend their

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data for migration governance purposes. Consequently, while these sources can significantly expand the scope and depth of available data for anticipatory methods, they also introduce a series of challenges. Indeed, as noted by Meissner and Taylor (2024), the primary commercial aims of these data providers—to maximize profit and expand market reach—can inadvertently influence the types of data collected and the methodologies used in analysis. Consequently, their use can potentially introduce skewed perspectives and outcomes into migration studies and policy, underscoring the necessity for careful evaluation and ethical oversight to ensure the reliability and appropriateness of the data utilized for predictive models.

Further, implementing and adopting anticipatory methods in migration policy necessitates the development of adequate capacity within institutions and among policymakers. This challenge involves providing training and resources to enhance data literacy, analytical skills, and the ability to interpret and utilize anticipatory insights effectively. For instance, the Mixed Migration Centre (2018) implemented exercises to build capacity for various stakeholders to effectively plan mixed migration including crisis scenarios. Capacity-building efforts may also focus on promoting a culture of evidence-based decision-making and fostering a multidisciplinary approach to understanding and addressing migration dynamics, ultimately moving from anticipatory exercises to policymaking processes.

Finally, engaging relevant stakeholders is crucial for the successful integration of anticipatory methods in migration policy. This challenge involves fostering collaboration and communication among policymakers, researchers, civil society organizations, and affected communities. An example of this is ILDA and Hivos (2021), where a group of textile workshops where different stakeholders, including migrants, meet to reflect on the present and future of migration processes through the creation of an embroidered textile piece based on the narratives and stories of individuals who have chosen to migrate from other countries to Uruguay. Stakeholder engagement facilitates the sharing of knowledge, data, and expertise, ultimately (a) ensuring that anticipatory methods are informed by diverse perspectives and contextual insights and (b) potentially enabling transparency and accountability in migration policy decision-making processes.

In the intricate process of decision-making regarding the potential adoption and application of anticipatory methods, a nuanced exploration of the opportunities and challenges becomes crucial. Indeed, this analytical scrutiny is important to foster an informed decision-making process in the formulation and implementation of anticipatory methods for migration policies.

3. Methodology

This study adopts a desk research methodology, leveraging an extensive analysis of secondary data sources and a curated repository of over 80 real-world use cases of anticipatory methods applied within the context of migration policy. The primary objective of this research was to construct a comprehensive taxonomy of anticipatory methods. This section outlines the systematic process undertaken to achieve this objective, detailing the selection process to identify use cases, tools, data sources, and methods.

For the selection of tools, data sources, use cases, and methods, the initial step entailed the identification of keywords and search terms directly related to anticipatory analysis, migration studies, and policy development. This phase was crucial for ensuring the search strategy was both focused and expansive, capable of capturing a wide array of relevant literature and resources. The keywords used were "anticipatory analysis," "forecasting migration," "migration foresight," "migration data sources," "big data for migration" and "policy making tools." In addition to the keywords, a series of boolean operators were employed: ("anticipatory analysis" OR "forecasting" OR "foresight" OR "data sources" OR "big data" OR "policy tools") AND ("migration" OR "migration policy").

3.1. Selection of use cases

A repository of real-world use cases was compiled by scouring reports from international organizations, government agencies, nongovernmental organizations (NGOs), and academic institutions involved in

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migration research and policymaking. We then curated and selected 80 use cases, including them in the final repository of cases that guided the development of the taxonomy. The selection criteria included:

1. **Relevance to Migration Anticipation:** The use case must directly pertain to the anticipation of migration, addressing challenges, trends, or scenarios related to the movement of populations.
2. **Demonstrable Anticipatory Methodology:** Each use case should showcase a clear anticipatory methodology, whether it be statistical models, scenario planning, simulation and modeling, or other forward-thinking approaches.
3. **Methodological Development or Innovation:** This criterion focuses on proposing new approaches, frameworks, or strategies for addressing migration challenges. Innovative methods, mixed-methods approaches, or adaptations of existing ones are considered valuable.
4. **Real-World Objective:** Use cases should demonstrate intent toward practical application in real-world scenarios, with a focus on tangible outcomes or insights that contribute to informed decision-making. However, given the nascent nature of this field, the repository includes experimental and research-oriented efforts, as long as they have a practical, real-world-oriented perspective.

To use the repository of use cases as a tool to develop the taxonomy, each case was analyzed according to a series of categories, including: anticipatory method used, tools used, data used, timeframe of anticipation, and maturity level.

3.2. Selection of tools and data sources

The development of comprehensive lists for tools and data sources utilized within anticipatory analysis was carried out through a desk review. This systematic process was aimed at ensuring the compilation was both broad and relevant to the field.

The initial step entailed the use of keywords and Boolean operators highlighted above. The next stage involved conducting searches across multiple academic databases and institutional repositories. In particular, databases such as Web of Science, Scopus, and Google Scholar, alongside repositories like the Social Science Research Network (SSRN) and institutional archives, were consulted. This step was aimed at identifying peer-reviewed articles, white papers, and reports that mention or discuss tools and data sources in the context of anticipatory analysis.

All identified sources were subjected to a screening process to evaluate their relevance to the objectives of the list. This involved reviewing abstracts and, where necessary, the full text to determine the significance of the tools and data sources mentioned in each document. To define the relevance of identified sources during the screening process, we used criteria focused on how well each source aligned with our research objectives, specifically its contribution to understanding or application within anticipatory analysis in migration studies and policy development. Any relevant tool or data source was then included in the list.

3.3. Selection of methods

To begin the analysis of the repository, we initially conducted a literature review to pinpoint the most frequently cited anticipatory methods within the domain of migration policy. This exercise enabled us to compile a list of such methods, selected based on their prevalence and relevance. For each case, we identified the specific method employed from our curated list, classifying the case accordingly.

In the context of this paper, methods refer to the various approaches and techniques used to anticipate and analyze migration trends, challenges, and opportunities. These methods are employed to make informed decisions and develop policies related to human migration. They can include a wide range of strategies to gather and interpret data and insights in the field of migration policy.

The selection criteria for the list of anticipatory methods for migration policy included:

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1. Usage in Migration Policy: This criterion focused on the relevance and applicability of the method within the context of migration policy. Methods that have a history of being used in the field were prioritized.
2. Proven Efficacy: Methods with a demonstrated track record of effectively providing valuable insights and facilitating decision-making in migration policy were given preference.
3. Innovative Data Sources and Tools: A significant emphasis was placed on methods that displayed a propensity for integrating innovative data sources and advanced tools. This recognition of innovation was identified through the compilation of a repository of use cases where these methods had effectively leveraged modern resources to enhance their capabilities.
4. Interdisciplinary Applicability: Consideration was given to methods that possess the capacity to bridge different disciplines and fields of knowledge, acknowledging the multifaceted nature of migration issues and their intersection with various fields.

The criteria of selection for the list of methods were intentionally designed to encompass fairly broadly understood methods while excluding those that are similar or contained within the broader method already included. This selection approach serves the purpose of offering a comprehensive and diverse toolkit for practitioners in the field of migration policy. The rationale for this lies in the attempt to minimize redundancy, ensuring that practitioners have access to a wide range of approaches for addressing the multifaceted challenges of migration policy.

Indeed, excluding methods that are too specific or closely resemble broader methods already listed helps to avoid repetition. It ensures that each included method brings a unique perspective and approach to the table, enhancing the overall diversity of the list. For example, the list includes Trend Analysis but excludes Extrapolation, as Extrapolation is a specific kind of trend analysis. Similarly, it encompasses Participatory Action Research and Citizen Panels but excludes Appreciative Inquiry, which is a specific approach within those broader methods. Additionally, it includes the Delphi Method, Expert Panels, and Expert Interviews but excludes Argument-based forecast, which can be seen as a specific approach within the Delphi method.

By employing these criteria and conducting analyzing the methods through the repository of use cases, the list was constructed to reflect a balanced and forward-looking approach in the field of migration policy. These methods, with their adaptability to new data sources and tools, can empower stakeholders to address the complexity of human migration with a versatile and informed perspective. Please see Figure 1 for the complete list of selected methods, and find definitions of all the methods included in Supplementary Appendix A.

Scenario Planning	Futures-creativ e Models	Cross-Impact Analysis	Horizon Scanning	Risk Assessment	Simulation and Modeling
Environmental Scanning	Science Fiction Narratives	Backcasting	Morphological Analysis	Technology Roadmapping	Early Warning Systems
Trend Analysis	Delphi Method	Participatory Action Research	System Dynamics Modeling	SWOT Analysis	Counterfactual Analysis
Weak Signal Analysis	Expert Panels	Focus Group Discussions	Game Theory	Innovation Workshops	Citizen Panels
Wildcards Analysis	Expert Interviews	Narrative Interviews	Red Teaming	Stress Testing	

Figure 1. *List of methods considered in this paper. Developed by the authors.*

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To further validate the compilation and fill any potential gaps in the selections made for tools, methods, and data sources, consultations with experts in the fields of migration studies and data-driven policy were conducted.

3.4. Research limitations

Acknowledging the pursuit undertaken in this examination of anticipatory methods in migration policy, it is imperative to delineate certain inherent limitations.

Firstly, the categorization into Experience-based, Exploration-based, and Expertise-based methods, while providing a structured framework, may oversimplify the nuanced nature of these methods, especially given each method can vary in its aim and application based on the data sources and tools used. The classification is thus subject to context and interpretation.

Secondly, the assessment of maturity and timeframe of prediction involves a degree of subjectivity. The assignment of scores is influenced by contextual factors, and different evaluators might allocate scores differently.

Additionally, the paper's scope is inherently constrained, focusing on a curated selection of anticipatory methods. The exclusion of certain methodologies may limit the comprehensiveness of the analysis.

Moreover, the analysis is contingent upon the availability and quality of data and information related to each method. Variability in data sources may impact the accuracy and reliability of the findings.

Finally, the dynamic nature of migration policy and the evolving landscape of anticipatory methods necessitate an acknowledgment that the conclusions drawn are context-dependent and subject to change over time.

In sum, while this study aims to offer insights into anticipatory methods, these limitations underscore the need for continued research, nuanced interpretation, and an awareness of the evolving nature of both migration policy and the methodologies employed for anticipation within this domain.

4. Shifting paradigms: forecast and foresight

This chapter explores changes in anticipatory methods within migration policy, transitioning from traditional forecasting to an integrated foresight approach, providing an overview of how these methods are evolving.

Traditionally, in the realm of anticipatory methods, a clear demarcation existed between foresight and forecast. On the one hand, forecast predominantly relies on quantitative techniques to predict future trends, utilizing historical data, mathematical models, and statistical analyses to provide numerical predictions applicable to the short-to-medium term, seeking to facilitate expedited policymaking, resource allocation, and logistical planning (Carammia et al., 2022). On the other hand, foresight methodologies conventionally leaned on qualitative insights to explore future possibilities, employing expert judgment, scenario planning, and holistic exploration to envision potential future scenarios (Napierała et al., 2022). This qualitative approach has been characterized by a more long-term perspective, which seeks to explore a spectrum of potential futures in the long run.

More recently, this once-clear distinction between quantitative forecasting and qualitative foresight has begun to blur. New methodologies that embrace a mixed-method approach are emerging, challenging traditional paradigms and offering new pathways for understanding complex phenomena. Indeed, the latest methodological innovations redirect attention away from the traditional dichotomy between quantitative and qualitative methodologies and instead center on the core objective of the anticipatory method—namely, whether it aims to (a) predict future trends, which we classify as Forecast, or (b) explore future scenarios, which we classify as Foresight.

While both categories may harness a blend of quantitative and qualitative insights, they differ in the following ways (Figure 2):

Mindful of this paradigm shift, the next section will delve into the different tools and data sources identified (see Methodology) for the development of the taxonomy.

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Aspect	Forecast Methods	Foresight Methods
Focus	Predict future trends	Explore future scenarios
Purpose	Provide data-rich projections for decision-making, informed by qualitative context	Facilitate the adaptation of migration public policies with a view that can combine quantitative and qualitative elements to explore and achieve desired scenarios
Time Horizon	Typically, shorter-term forecasts	Longer-term scenarios and strategies
Predictive vs. Imaginative	Emphasis on prediction and specific trend identification	Emphasis on imaginative exploration and considering a range of possibilities

Figure 2. *Differences between foresight and forecast methods. Developed by the authors.*

5. A deep dive into tools and data sources for anticipatory methods

In the ever-evolving landscape of anticipatory methods for migration policy, innovation is a dynamic force propelling the field forward. This seems to be happening in two main ways: first, one of the significant shifts lies in the blurring of boundaries between quantitative forecasting and qualitative foresight, as emerging mixed-method approaches challenge traditional paradigms. This transformation opens up new pathways for understanding complex phenomena, particularly in the context of human migration flows.

Second, the innovation happening today is not necessarily rooted in the development of entirely new methodologies, but rather in how existing methods are adapted and enhanced. Indeed, innovation seems to extend to the utilization of diverse tools and data sources that bolster the effectiveness of existing methods, offering a more comprehensive and timely perspective on migration trends.

In the context of this paper, tools refer to the specific instruments or technologies used to support and enhance the effectiveness of these methods. They encompass a diverse set of resources and technologies that facilitate data collection, analysis, and decision-making in the context of migration policy. These tools can include both quantitative and qualitative data collection and analysis tools, as well as innovative software and techniques that help enhance anticipatory methods. See Figure 3 for a series of tools that may be used for anticipatory methods for migration policy, alongside examples of real-world applications. The table has been organized according to ten categories of tools, which were developed to systematically organize the various tools used in migration policy.

On the other hand, in this paper, data sources refer to the various origins of information utilized to feed these anticipatory methods. This encompasses both traditional and nontraditional data, each offering unique insights into migration dynamics. Traditional data sources often include official statistics, surveys, and census information, which provide a historical perspective and baseline for migration trends. These data sources are pivotal for establishing long-term patterns and are often considered reliable due to their standardized collection processes.

However, this research focuses on nontraditional data sources. Indeed, increasing levels of datafication and the rising adoption of digital systems to operate within the migration policy field have brought about a

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Quantitative Data Collection and Analysis	Qualitative Data Collection and Analysis	Modeling and Simulation	Scenario Building and Planning	Environmental Scanning and Trend Analysis
• Google Alerts • Social media analytics platforms • News aggregators • Machine learning (ML) techniques • Statistical software (e.g., Tableau, R) • Data visualization tools • Weak signal detection algorithms • Text mining software • Bibliometrics techniques	• Interview protocols • Computer assisted qualitative data analysis software (e.g., NVivo, ATLAS.ti, Maxqda) • Qualitative data analysis tools • Qualitative interview guides • Audio recording tools • Online focus group platforms (e.g., Forsta) • Facilitation guides • Video conferencing tools	• System dynamics software (e.g., Vensim, Stella) • Causal loop diagramming tools (e.g., Causal Loop Diagram) • 3D modeling software (e.g., Vectary) • Machine learning (ML) techniques • Game theory software (e.g., Gambit, NetLogo) • Decision tree analysis platforms (e.g., Weka)	• Scenario planning software • Stakeholder engagement tools • Backcasting templates • Future visioning workshops • Strategic planning software • Impact matrix tools • Influence diagram software • Decision analysis platforms	• Horizon scanning platforms (e.g., CABI) • Environmental monitoring software • Trend analysis frameworks • Morphological analysis grids • Structured brainstorming templates • Morphological analysis software • Geographic Information Systems (GIS) • Benchmarking techniques
Expert and Stakeholder Engagement	**Creative and Collaborative Techniques**	**Futurist Tools and Methods**	**Risk Assessment and Management**	**Early Warning and Counterfactual Analysis**
• Online Delphi platforms (e.g., Delphi Decision Aid) • Survey maker tools (e.g., Qualtrics, Limesurvey) • Structured questionnaires • Virtual meeting platforms (e.g., Zoom, MS Teams) • Consensus-building frameworks • Expert panel facilitation tools	• Visual mapping tools (e.g., MindMeister) • Futures wheel for visualization • Design thinking methodologies • Creative storytelling tools • Collaborative analysis software (e.g., ATLAS.ti, Maxqda) • Futures artifacts • Science fiction literature	• Roadmapping software (e.g., Roadmunk, Aha!) • Strategic planning tools (e.g., Notion, Asana) • SWOT analysis software (e.g., SafetyCulture, SmartDraw) • Ideation and brainstorming platforms (e.g., Miro, Lucidspark, Stormboard, Coggle)	• Risk assessment and management tools (e.g., RiskWatch) • Predictive analytics tools (e.g., IBM Watson Studio, RapidMiner Studio) • Risk modeling software (e.g., Cube)	• Early warning platforms (e.g., ECDC Epidemic Intelligence) • Predictive analytics tools (e.g., RapidMiner Studio) • Counterfactual frameworks • "What-if" scenario analysis tools

Figure 3. *Categories of tools for anticipatory methods in migration. Developed by the authors.*

variety of new data sources. These offer real-time insights and the ability to detect emerging trends more rapidly, and are often referred to as "nontraditional data source," which The University of Manchester Global Development Institute defines as "data that is digitally captured (e.g. mobile phone records and financial data), mediated (e.g. social media and online data), or observed (e.g. satellite imagery)" (Albanna et al., 2021). Figure 4 illustrates a range of nontraditional data sources utilized in migration policy. These include sources like social media activity and satellite imagery, which are pivotal for real-time analysis and early trend detection.

6. Toward a new taxonomy of anticipatory methods

A paradigm shift that has made the distinction between quantitative forecasting and qualitative foresight less distinct, which necessitates for new ways of understanding how different anticipatory methods are used for migration policymaking. In this section, we delineate a taxonomy of anticipatory methods proposing a categorization into three distinct subcategories: (1) Experience-based, (2) Exploration-based, and (3) Expertise-based methods (see Figure 5). The focus will be on what the practical applications of these methods are, and how both traditional and nontraditional data sources[2] play a pivotal role within each of these categories.

Below we illustrate the allocation of these methods within the three categories we have identified in this research, namely (1) Experience-based Methods, (2) Expertise-based Methods, and (3) Exploration-based Methods (see Figure 6).

The following sections will thus explore each of these categories, highlighting their value, practical applications, and potential uses of traditional and nontraditional data.

6.1. Experience-based methods: understanding lived experiences for anticipation

Experience-based methods in the realm of migration policy focus on gaining insights from the lived experiences of individuals involved in migration processes. These methods allow policymakers to tap into the lived experiences, challenges, and aspirations of individuals and communities, fostering a more empathetic and holistic approach to policy development.

[2] In this paper, non-traditional data is defined as "data that is digitally captured, mediated or observed using new instrumentation mechanisms, often privately held and used for purposes unrelated to its initial collection" (Govlab, n.d.).

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Social Media Posts	Social media platforms like Twitter, Facebook, and Instagram can serve as a source for monitoring discussions, sentiments, signals of migration intentions, and real-time events related to migration.	**Weather and Climate Data**	Weather data from sources like the National Oceanic and Atmospheric Administration (NOAA) can be used to assess the impact of extreme weather events on migration patterns.
Crowd-sourced Data	Platforms like Ushahidi and FrontlineSMS allow the collection of real-time data from individuals and communities, which can include information on migration patterns, emergencies, and needs.	**Remote Sensing Data**	Data from remote sensing technologies, like drones and LiDAR, can offer information on border surveillance, environmental factors, and disaster response.
Satellite Imagery	High-resolution satellite imagery, such as that provided by Planet Labs or DigitalGlobe, can be used to track border movements, refugee camp expansion, and natural disaster impact on migration.	**Humanitarian Data Exchange (HDX)**	HDX offers data on humanitarian responses and activities related to migration, including resource allocation and needs assessments.
Mobile Phone Data	Data from mobile network operators, including call records and location data, can help track the movements of internally and internationally mobile populations and provide insights into migration trends.	**Health Records and Epidemiological Data**	Data from community health workers, digital health apps, wastewater data for infection rates, telemedicine platforms, and epidemiological data collected from non-traditional sources.
Financial Data	In the context of migration policy analysis, non-traditional financial data can encompass various sources such as cryptocurrency-based transactions, mobile money transfers, cross-border financial flows, and informal remittance networks.	**Digital Trace Data**	Analysis of digital traces, such as Wi-Fi connections, can help track the movement of migrants in transit.
Online Forums and Communities	Online discussion forums, such as Reddit, comments on online news, or specialized migration-related platforms, can provide qualitative insights into migrant experiences and concerns.	**Flight and Travel Data**	Airline flight data and travel booking information can provide insights into international travel patterns and destinations of migrants.

Figure 4. *Categories and definitions of nontraditional data sources for anticipatory methods in migration. Developed by the authors.*

Through the lens of people's experiences and viewpoints, it is possible to create and explore a multitude of scenarios. This in-depth exploration provides policymakers with a comprehensive understanding of these potential pathways, which, in turn, inform their decision-making process.

In the complex landscape of migration policy, understanding the experiences of those directly affected by migration processes provides vital context for crafting policies that are relevant, effective, and responsive to people's needs.

A few examples of Expertise-based anticipatory methods include narrative interviews, focus group discussions, and participatory action research (see Figure 7). First, narrative interviews can delve into the personal stories and lived experiences of migrants, potentially revealing their needs and the challenges they encounter (Mixed Migration Centre, 2022). These intimate narratives offer valuable insights that can inform more compassionate and effective migration policies. Similarly, focus group discussions (Bivand Erdal et al., 2023) bring diverse voices together in structured yet interactive settings. In the context of migration, they help policymakers explore the collective experiences and concerns of migrants and host communities. Then, participatory action research (Vah Jevšnik and Toplak, 2014) takes this a step further by engaging the affected communities in the research process itself. In this collaborative approach, migrants and host communities actively participate in problem identification, research, and solution development.

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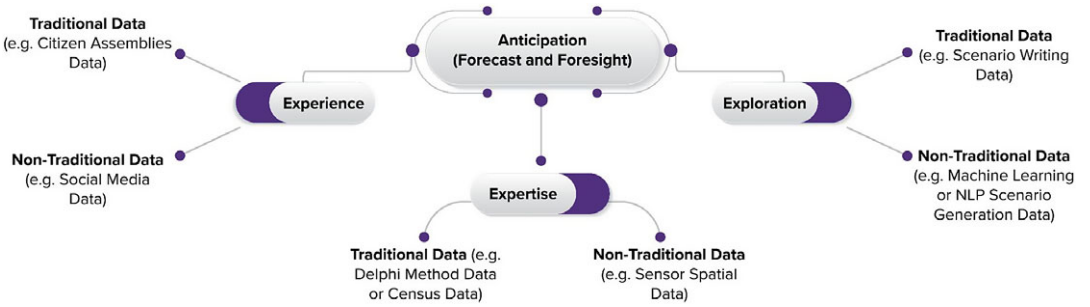

Figure 5. *Visualization of the BD4M taxonomy of anticipatory methods. Developed by the authors.*

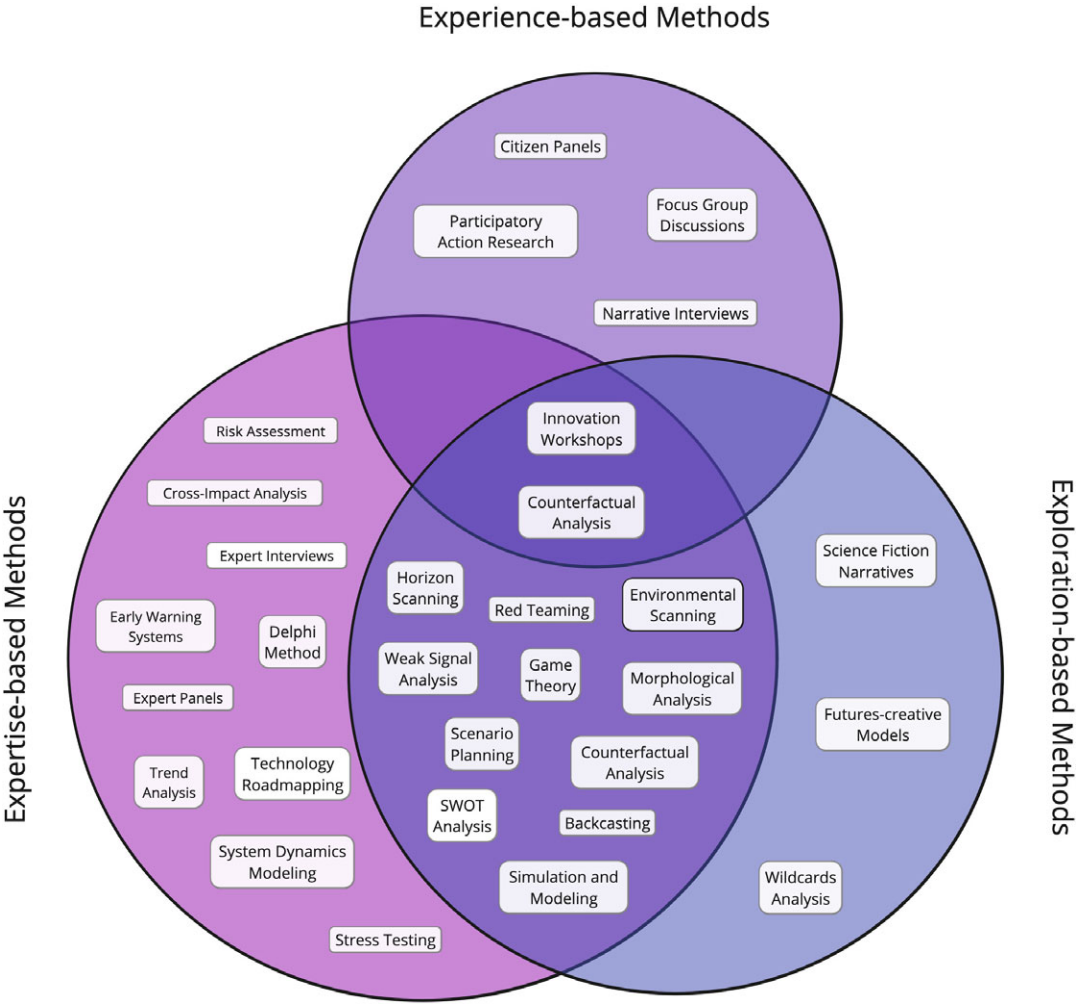

Figure 6. *Allocation of methods. Developed by the authors.*

When it comes to anticipating migration trends, both traditional and nontraditional data sources can be valuable. In the context of experience-based methods, traditional data can be gathered from citizen assemblies, providing a structured and face-to-face approach to understanding public perceptions and concerns about migration. Conversely, nontraditional data, like social media analytics, offers a real-time

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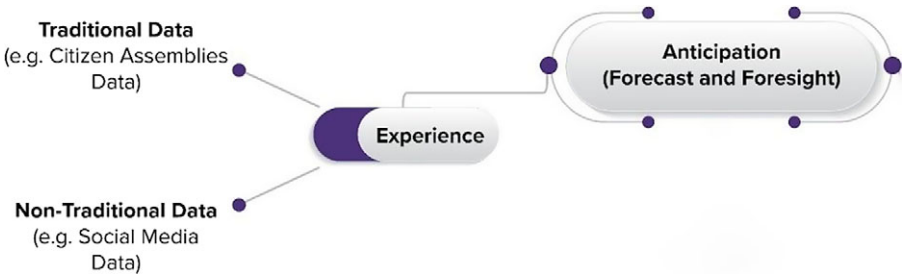

Figure 7. *Visualization of the Experience-based methods category from the BD4M taxonomy of anticipatory methods. Developed by the authors.*

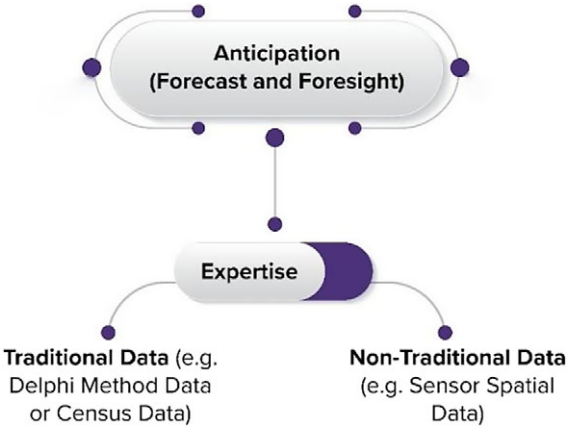

Figure 8. *Visualization of the Expertise-based methods category from the BD4M taxonomy of anticipatory methods. Developed by the authors.*

window into public sentiment and emerging trends. Monitoring conversations and trending topics related to migration on social media platforms can provide early indicators of evolving migration patterns. Combining traditional data, like those resulting from citizen assemblies, with nontraditional data sources, like social media analytics, can enhance policymakers' understanding and ability to anticipate and respond to migration trends effectively. However, in this first category of anticipatory methods as well as in the other two, it is important to consider the potential challenges associated with the use of nontraditional data, which include (a) a lack of a specific procedure that outlines the variables of interest before the data is collected (Chafetz et al., 2022), (b) bias (Marcucci et al., 2022), (c) discriminatory surveillance and lack of group privacy (Verhulst and Marcucci, 2023), and (d) data colonialism, especially when the data is owned or enabled by private actors (Viera Magalhães and Couldry, 2021).

6.2. Expertise-based methods: drawing on specialized knowledge for anticipation

Expertise-based methods rely on the insights and judgments of subject matter experts (see Figure 8). In the context of migration policy, these methods are about using expert opinions to make well-informed decisions. Migration policies involve complex international agreements, humanitarian considerations, and diverse populations. Expertise-based methods are vital for anticipatory decision-making, drawing on specialized knowledge and diverse perspectives.

These methods provide a structured way to access expert insights and knowledge, ensuring well-informed and comprehensive migration policy decisions. They aim to foster knowledge exchange among

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and from people that work in the field of migration and that bring in different, often multidisciplinary expert perspectives.

A few examples of Expertise-based anticipatory methods include the Delphi method (Bijak and Wiśniowski, 2010), expert panel (Galbraith, 2018), and expert interviews (Friedrich-Ebert-Stiftung et al., 2017). The Delphi method aggregates diverse expert opinions, fostering consensus and reliability in anticipatory insights for migration policy. Expert panels bring together a wide range of knowledge and viewpoints, promoting robust discussions and inclusive decision-making. Expert interviews offer deep dives into specialized knowledge, allowing policymakers to gain nuanced insights, particularly useful when dealing with complex issues such as asylum policy or labor migration regulations.

Both traditional and nontraditional data sources can play important roles in Expertise-based anticipatory methods for migration policy. Traditional data, including government statistics and historical records, forms the bedrock upon which experts base their assessments and predictions using methods like the Delphi technique and expert panels. On the other hand, nontraditional data, such as sensor spatial data (which is indeed gathered from experts) or data from digital communication channels among expert stakeholders can complement these methods by offering real-time and crowd-sourced information that captures early signals of potential migration trends. In expert interviews, this dynamic data source can ensure that experts remain attuned to evolving public sentiments and emerging concerns regarding migration, enabling a more adaptive and responsive approach to policymaking that incorporates both historical context and the current, ever-changing landscape of migration issues.

6.3. Exploration-based methods: inspiring innovative policies through unconventional thinking

Exploration-based methods encourage unconventional thinking and innovative strategies. These methods are about thinking outside the box and exploring unconventional scenarios (see Figure 9).

Exploration-based methods are relevant as they inspire creative solutions to address both expected and unexpected challenges in migration. These methods empower migration policymakers to think outside the box and explore unconventional scenarios. For instance, when crafting integration strategies for refugees, Exploration-based techniques can be employed to envision unconventional pathways that foster economic self-sufficiency and social cohesion.

Concepts like wildcards, futures-creative models, and science fiction narratives inspire imaginative solutions, shaping visionary policies that are proactive and adaptable. First, wildcards (Centre for Strategic Futures, 2022) aim to explore unforeseen, low-probability high-impact events, enabling policymakers to prepare for sudden disruptions such as natural disasters or political revolutions. Another example of Exploration-based methods is futures-creative models (Bhagat, 2018), which encourage innovative thinking by pushing participants to envision alternative futures beyond conventional paradigms. In the context of migration, these models inspire inventive approaches to challenges like forced displacement and integration. Science fiction narratives (UNHCR Innovation Service, 2022), on the other

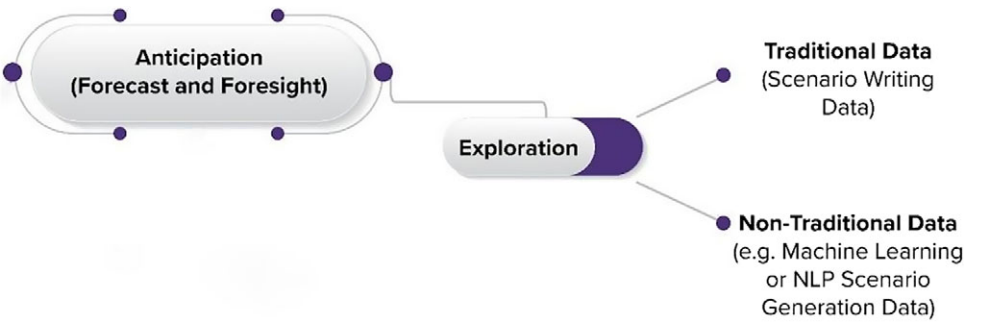

Figure 9. *Visualization of the exploration-based methods category from the BD4M taxonomy of anticipatory methods. Developed by the authors.*

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hand, provide a creative means to explore and communicate future scenarios influenced by factors such as technology, climate change, and geopolitics, allowing policymakers to engage with potential migration futures and stimulate discussions on policy implications and ethical considerations.

Traditional data in Exploration-based methods can be used in and sourced from a variety of methods, including scenario writing, scenario workshops, and historical migration trends. Scenario writing utilizes historical data and existing knowledge to construct alternative migration scenarios. Scenario workshops, then, draw on traditional data for discussions and brainstorming. Historical migration trends, rooted in traditional data sources, offer a foundation for understanding past migration dynamics, allowing policymakers to leverage historical patterns and insights for crafting imaginative scenarios and innovative policies. Nontraditional data sources, on the other hand, include satellite imagery, social media sentiment analysis, and mobile application data. Satellite imagery offers real-time, high-resolution information, making it invaluable for Exploration-based methods that require monitoring border movements, environmental shifts influencing migration, and assessing infrastructure developments. Social media sentiment analysis provides insights into public perceptions and evolving trends, facilitating the creation of imaginative scenarios and enhancing the creative thinking process of policymakers. When integrated, among themselves and with traditional data sources, these empower Exploration-based methods, allowing policymakers to anticipate and creatively respond to the multifaceted challenges of migration.

This section has attempted to show how each category, from experience-based to Expertise-based and Exploration-based methods, offers unique insights and value. To address the complexities of human migration comprehensively, it seems reasonable to encourage the amalgamation of established and innovative techniques, along with traditional and nontraditional data sources. This may empower policymakers to effectively navigate the intricate terrain of migration, forging policies that are both anticipatory and adaptive.

7. Conclusion

In light of the unprecedented increase in human mobility and the complexities associated with analyzing migration data, this paper sought to advance the application of anticipatory methods within the field of migration policy.

Initially, we noted the values and challenges of anticipatory methods in migration policy are multifaceted and significant. These methods offer benefits such as evidence-based policy development, adaptive strategies, efficient resource allocation, root cause analysis, and enhanced humanitarian aid. However, they also present challenges including conceptual issues like bias, uncertainty, and the legitimacy of preemptive interventions, alongside practical concerns like interdisciplinary collaboration, data quality, and stakeholder engagement. While anticipatory methods cannot fully eliminate uncertainty, they provide a framework for more precise and adaptable policies in an era of evolving migration patterns. The need for a nuanced understanding of these methods' opportunities and limitations is critical, highlighting the importance of developing a comprehensive taxonomy to guide their application.

In the above we have sought to develop a taxonomy that encompasses both traditional and innovative methods, integrating diverse data sources to navigate the complexities of migration effectively. The combination of Experience-based, Expertise-based, and Exploration-based methods, alongside a blend of traditional and nontraditional data, can empower policymakers to craft anticipatory and adaptive migration policies.

The taxonomy addresses gaps in the literature regarding guidance on anticipatory methods and incorporates recent innovations and changes in the field. Through the categorization of various tools and methodologies, our study aims to provide policymakers and researchers with a structured framework to move policymaking from a reactive to a more proactive stance, equipping stakeholders with the means to foresee potential migration scenarios and prepare accordingly.

As the field of migration policy continues to evolve, the integration of anticipatory methods represents a paradigm shift toward more informed, resilient, and adaptive policymaking processes. The insights gained from this study not only hope to contribute to the academic discourse on anticipatory methods in

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migration studies but also to offer practical guidance for the development and implementation of forward-thinking migration policies. Future research may focus on refining these methods, addressing the identified challenges, and exploring innovative applications to further enhance the effectiveness of migration policies in responding to the dynamic and often unpredictable nature of global migration patterns.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/dap.2024.56.

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Author contribution. Conceptualization: S.V., S.M.; Writing – review & editing: S.V.; Project administration: M.E.C.; Data curation: S.M.; Formal analysis: S.M.

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