

Governing the Digital Border: A Systematic Review of Interoperability, Accountability and Institutional Coordination in Immigration Information Systems

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Abstract

The global transition toward e-governance has transformed immigration administration by strengthening border security, improving service efficiency, and facilitating interagency coordination. Developed economies across Europe and Asia have implemented integrated Immigration Information Systems (IIS) that combine real-time data, biometrics, and interoperable digital frameworks to manage migration securely and accountably. Nevertheless, substantial disparities persist between developed and developing countries because of limited interoperability, insufficient capacity, institutional fragmentation, and data-security concerns. This study systematically reviews peer-reviewed literature published from 2015 to 2025 to examine how interoperability, accountability, and institutional coordination can be achieved through IIS. Guided by PRISMA principles, the review synthesizes evidence from empirical studies, policy frameworks, and international case studies, focusing on technological, semantic, and organizational interoperability. It also examines accountability mechanisms related to system security, transparency, data quality, regulatory compliance, and governance arrangements spanning agencies and national borders. The findings indicate that although the literature frequently prioritizes technological

interoperability, semantic alignment and strong organizational interoperability are essential for effective and sustainable system integration. Their achievement depends on clear legal mandates, robust governance structures, and effective interagency collaboration. Integrated systems in the European Union, Estonia, and Singapore demonstrate the potential of IIS to accelerate processing, strengthen security, and improve policy coherence, whereas many developing countries remain constrained by institutional, human-capacity, and infrastructural limitations. The review proposes a unified framework integrating interoperability, accountability outcomes, and institutional coordination. By synthesizing a fragmented body of scholarship and identifying critical research gaps, it provides evidence-based guidance for policymakers and system architects developing secure, accountable, and interoperable immigration information systems.

Keywords: Accountability; E-Governance; Immigration Information Systems; Institutional Coordination; Interoperability

INTRODUCTION

Globally, the move towards e-governance has reshaped, among other things, border administration and the delivery of immigration services. For instance, a good number of European and Asian countries have embraced electronic immigration systems which have in turn enhanced faster processing, reinforced security and improved the efficiency of service delivery (Kimolo & Casmir, 2024). For example, the Estonia's digital-first model integrates e-residency and other e-governance services to achieve smooth interaction between citizens and government institutions (Efthymiou, 2025). Similarly, Singapore has developed an integrated e-immigration system that enhances immediate and simultaneous information sharing across state databases, simplifying visa applications, residency permits and border control processes (Khan & Efthymiou, 2021). These few examples prove how digital technologies can simultaneously work in improving innovation, administrative efficiency and security across borders (Qureshi, 2007). However, matching modern technological capabilities with strong security measures is still the main challenge even in the technologically developed countries.

E-immigration refers to the use of information and communication technologies (ICTs) to deliver immigration services electronically. These include, particularly, the use of internet-based platforms to electronically deliver immigration services to all the customers

such as the citizens, foreigners, businesses as well as both government and private sector employees (Brouwer, 2020).

In the developed countries, interoperable electronic systems enable the provision of high-quality public services including immigration and financial services while simultaneously maintaining robust security standards (Concas *et al.*, 2024;Walsham *et al.*, 1988). Such security concerns are important, for example, according to Duic & Rošić (2021), there has been an increase of the number of international migrants worldwide by over 105 million between 1990 and 2017.

Early adoption of e-immigration systems has so far helped developed regions such as Europe to be in a better position to manage the growing migration flows (Casagran, 2021). These systems often focus on security-issues, concentrating on aspects such as biometric identification, automated border checkpoints and surveillance systems to strengthen security around the borders (Arya *et al.*, 2022). Worldwide, there have been security concerns including identity manipulation, fraud and terrorism. These have necessitated countries all over the world to desperately invest in IIS including biometric passports, e-visas and e-border control systems (Kipingu & Shayo, 2021). Even then, research spotlight simultaneously emerging risks such as counterfeiting and cyberattacks as well as unverified technological solutions such as mobile applications that connect visa applicants with verified agencies (Hanzlik & Kutylowski, 2021).

Apart from security concerns, the success of any integrated immigration information systems hinges heavily on the quality of the system itself, the quality of the information and service delivery (Wang *et al.*, 2020). Information quality refers the accuracy, completeness and reliability of the information. This has a direct effect on the user satisfaction and decision whether to use the system or not (Khelifi *et al.*, 2020). System quality, including reliability and functionality have the effect in indirectly supporting user satisfaction and organizational benefits (Akbar *et al.*, 2022). Service quality further shapes user experience and effectiveness of the overall system. This further undepins the need for balancing efficiency with responsiveness (Aden, 2020).

While there have been remarkable progresses in the developed countries in relation to IIS integration, many developing countries still face challenges in terms of interoperability and infrastructure (Krimmer *et al.*, 2022). Advanced economies are reported to be in mature stages of digital transformation, on the other hand, developing countries are still in the early

phases of e-government development (Akbar *et al.*, 2022). Essentially, the implementation of effective Integrated Information Systems is important for both developed and developing countries to enhance accessibility, efficiency and service quality (Varastika *et al.*, 2025).

For example, in the European Union, the 2019 Interoperability Regulations strengthened coordination in both border security and migration information systems. This has been reported to have positive results in data sharing and efficiency in border operations (European Commission, 2023). Thus, for effective immigration management, there need to be both domestic integration among national agencies and international cooperation among neighboring states. The focus areas include the ports of entry where harmonized procedures and standards are essential for efficient service delivery and security (European Union, 2020).

Effective immigration management is categorized into two dimensions: international integration between neighboring countries and domestic integration within a country or a customs union (Ally & Otieno, 2020). Both of these types require interagency coordination and collaboration at border check-points, for example, harbors and land border points of entry collectively referred to as ports of entry for the efficient functioning of these border institutions as illustrated in Figure 1.1:

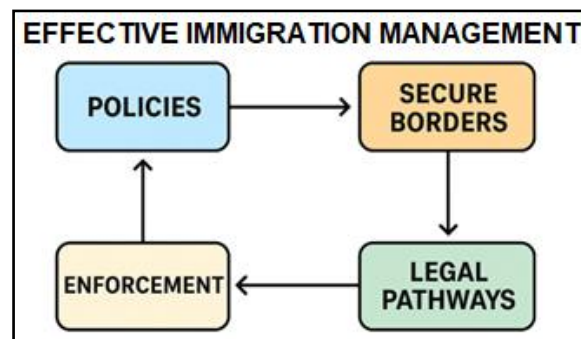


Figure 1. Conceptual Model of Immigration Information Systems

Source: Ally & Otieno (2020)

As illustrated in figure 1, the four components are connected in a circular process. This indicates that policies influence border security, legal pathways and enforcement enabling continuous improvement. Then, operational experiences from borders, legal migration processes and enforcement in turn influence and improve policy reforms. Therefore, the justification to thoroughly discuss the concept of an integrated immigration information system in this study stems from the need to achieve interoperability, accountability and institutional coordination. The study's objectives are guided by the following research questions (RQs)

RQ1: How can immigration information systems achieve interoperability, including technological, semantic and organizational dimensions across different countries?

RQ2: What does institutional coordination contribute to the successful integration of immigration information systems, including interagency collaboration, governance structures, resource capacity and cross-border cooperation?

RQ3: How can an integrated immigration information system contribute to the accountability through data quality, system security, transparency and user satisfaction mechanisms?

An Overview of Immigration Information Systems

Immigration Information Systems (IIS) refers to the collection of online and digital platforms, databases and applications that the countries use to control the movement of peoples across borders, regulate residency and citizenship as well as enhance national security and efficiency in the delivery of public services (European Commission, 2021). Hence, IIS is a very important component within the broader e-government ecosystem, it functions as mission-critical systems that integrate legal, administrative, security and service-oriented processes. They typically streamline core immigration processes such as visa applications and issuance, border entry and exit, acquiring residence permits, seeking, acquiring and management of asylum and refugee as well as processing for citizenship and compliance monitoring (Casagran, 2021).

Early systems focused primarily on record keeping and border enforcement. By contrast, modern IISs emphasize on immediate data exchange, automation and interoperability across multiple agencies and countries and increasingly, across country borders (Krimmer *et al.*, 2022). This evolution functions as an evidence for the growing migration flows, intensified security concerns and the need for more transparent, citizen-centered and efficient public services (Čižiūnienė *et al.*, 2024).

There are several interrelated subsystems that are comprised within the IIS. These include: travel document systems such as e-passports and machine-readable visas, biometric registration, border control systems particularly e-gates, passenger information systems, entry–exit systems, case management systems for permits, asylum as well as applications for citizenship (Arya *et al.*, 2022). Interoperability enhances heterogeneous systems, even those

developed by different vendors, at different times and places and for different institutional uses. This in turn enhances a meaningful exchange of data and sharing of information across national and international agencies (European Union, 2020). In terms of immigration, this includes technical interoperability which means system-to-system connectivity and data exchange standards; semantic interoperability which means shared data definitions, classifications and meanings as well as organizational interoperability which means aligned procedures, legal frameworks and institutional responsibilities (Krimmer *et al.*, 2022).

Another core dimension embedded in IIS design and implementation is accountability. In essence, immigration systems handle highly sensitive and personal biometric data. This makes quality data handling, access control, audit trails and transparency sensitive concerns (Al-Rahmi *et al.*, 2021). Well-designed IIS must therefore integrate effective mechanisms for data validation, role-based access controls, transaction logging and compliance with legal and ethical data protection (Alduaij *et al.*, 2024).

The last dimension, institutional coordination also supports both interoperability and accountability in the immigration information systems (Nguyen, 2021). IIS essentially involves multiple actors. These include: border police, immigration departments, foreign affairs ministries, customs authorities, national security institutions as well as labor agencies (United Nations, 2022). In that case, effective coordination requires clear governance structures, shared protocols, defined roles and responsibilities together with sustained interagency collaboration at ports of entry and across administrative boundaries (Ally & Otieno, 2020). Figure 2 summarizes this elaboration:

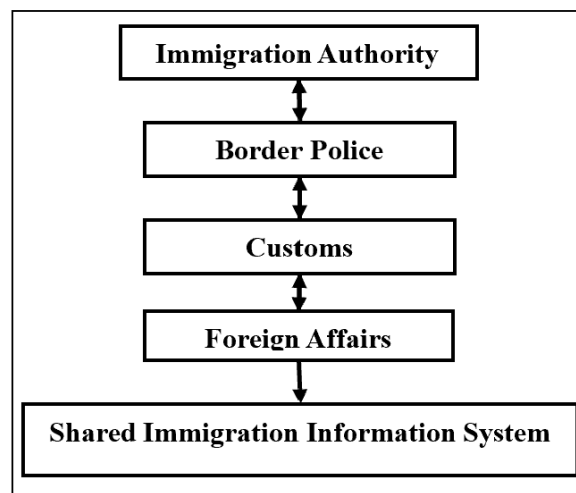


Figure 2. Institutional Coordination in Immigration Information Systems
Source: Ally & Otieno (2020)

As mentioned earlier, developed countries generally operate more mature systems with advanced integration and automation as a result of significant technological advancements. On the other hand, many developing countries face challenges emanating from inadequate infrastructure, skills shortage, financing, legal frameworks and institutional readiness (Akbar *et al.*, 2022). These disparities highlight the need for considering IIS not merely as technical solutions, but as socio-technical systems shaped by policy choices, organizational capacities and other factors related to the real contexts (Jones & Pla, 2020).

In the context of this review, Immigration Information Systems are therefore conceptualized as integrated socio-technical infrastructures designed to enhance immigration governance through interoperability, accountability and institutional coordination (Bindemane *et al.*, 2018). This overview provides the foundation for analyzing how different regions and countries across the globe design, implement and integrate IIS and how these systems contribute to the effective immigration management in an increasingly modernized and interconnected world.

METHODOLOGY

The current study adopted a Systematic Literature Review (SLR) and guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, 2020) framework. The PRISMA framework for selecting the studies is summarized in the Figure 3.

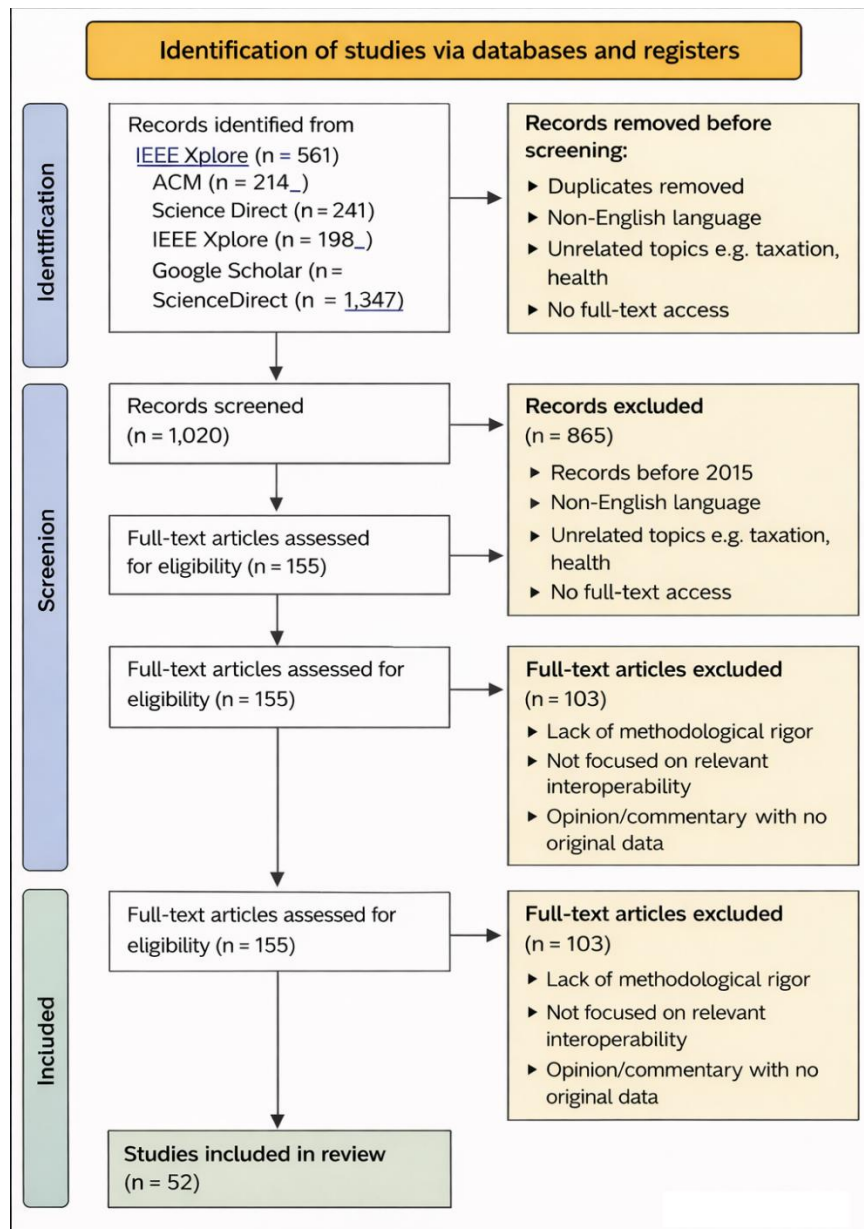


Figure 3. PRISMA 2020 Flow Diagram for Study Selection

Source: Modified from Page et al., (2020)

The PRISMA framework was selected to ensure replicability, transparency and methodological rigor in identifying, screening and synthesizing literature in relation to the question under study, in this case, the integration of Immigration Information Systems (IIS).

SLR Overview and Research Objectives

Specifically, the review aimed to focus on interoperability, accountability, and institutional coordination.

- Identify how can immigration information systems achieve interoperability, including technological, semantic and organizational dimensions across different countries.
- Examine how institutional coordination contribute to the successful integration of immigration information systems, including interagency collaboration, governance structures, resource capacity and cross-border cooperation.
- Examine how integrated immigration information system contribute to the accountability through data quality, system security, transparency and user satisfaction mechanisms.

Search Strategy

The studies for review were included if they were published between 2015 and 2025, they were in English, focused on Immigration Information Systems, border control systems or digital identity systems and if they addressed at least one of the similar themes namely: technological, semantic or organizational interoperability, institutional coordination or interagency collaboration and accountability (data quality, system security, transparency, user satisfaction). Moreover, reviewed studies were those which were peer-reviewed journal articles, conference papers or reports from reputable international institutions and which provided empirical evidence, conceptual frameworks or systematic reviews.

Conversely, studies were excluded if they focused solely on unrelated e-government services such as taxation and health systems, were published before 2015, were not in English or not available in English versions, lacked methodological precision or analytical depth, were duplicates across databases and if they were inaccessible in full texts. The study selection followed the PRISMA 2020 flow process starting with identification where the initial database search produced 312 records from Scopus, 241 records from Web of Science, 198 records from IEEE Xplore, 420 records from Google Scholar and 176 records from ScienceDirect. This amounted to a total of 1,347 identified records. During this phase, 327 duplicates were removed thus remaining with a total of 1,020 records.

Titles and abstracts were then screened against the inclusion criteria where 865 records were excluded at title/abstract screening and 155 records remained for full-text review. Further, full-text articles were assessed for methodological quality, relevance and thematic alignment where 103 full-text articles were excluded due to insufficient methodological clarity, missing clear links to interoperability or coordination and purely descriptive opinion pieces and thus remaining with 52 studies meeting eligibility criteria. After final quality assessment and thematic relevance verification, 47 articles remained. These

47 studies formed the empirical and conceptual foundation for answering the three research questions as established in the earlier sections.

In order to capture the country/region of study; type of Immigration Information System; interoperability mechanisms (technological, semantic, organizational); institutional coordination mechanisms, accountability measures (data quality, security, transparency, user satisfaction) and reported outcomes and challenges, a structured data extraction matrix was developed. Thereafter, an inductive–deductive thematic synthesis approach was applied to capture emerging themes across case studies. Furthermore, a comparative analysis was made across developed v/s. developing countries, centralized v/s. federated system architectures and high v/s. low governance maturity environments. This was instrumental in identifying structural patterns linking interoperability dimensions to accountability outcomes and institutional coordination effectiveness.

Data Extraction

A structured data extraction matrix was developed to ensure consistency and comparability across all selected studies. The following information was systematically extracted:

- Bibliographic details: author(s), year of publication, and source (journal, conference, institutional report).
- Country or region of study to enable geographical and contextual comparisons.
- Type of system examined (e.g., Immigration Information Systems, border control systems, digital identity systems).
- Technological interoperability (e.g., system integration, IT infrastructure, data exchange platforms).
- Semantic interoperability (e.g., data standards, shared vocabularies, data harmonization).
- Organizational interoperability (e.g., policies, governance arrangements, inter-agency workflows).
- Interagency collaboration frameworks.
- Data quality (accuracy, completeness, reliability).
- Challenges and limitations highlighted in each study

Outcomes

In this review, the main outcomes of interest from each selected study were conceptual, institutional, and technical characteristics describing how Immigration Information Systems (IIS) are integrated across different contexts. These outcomes comprised (i) the type and scope of IIS examined (e.g., border control systems, digital identity systems) and the country or regional context; (ii) the interoperability mechanisms adopted, including technological, semantic, and organizational dimensions; (iii) the institutional coordination arrangements, such as interagency collaboration frameworks, governance structures, and cross-border cooperation mechanisms; (iv) the accountability features reported, including data quality, system security, transparency, and user satisfaction; and (v) the reported outcomes and challenges related to system performance, integration effectiveness, and implementation constraints. All results pertinent to these predefined outcome categories were systematically collected. Where multiple descriptions were provided, the most comprehensive and analytically robust account was selected.

Handling of Missing or Ambiguous Data

To ensure the rigor and reliability of the review, clear procedures were established for handling missing or ambiguous data during the extraction and synthesis process. First, where studies contained incomplete information for specific variables (e.g., unclear interoperability dimensions or unspecified accountability measures), the available content was carefully examined and interpreted using contextual clues from the full text, including methodology, findings, and discussion sections. Second, when ambiguity persisted, conservative coding was applied, whereby data were either categorized under “not specified” or excluded from that specific analytical dimension to avoid over-interpretation. Third, in cases where multiple descriptions or inconsistent reporting appeared within the same study, priority was given to the most detailed, methodologically sound, and internally consistent account. Fourth, studies with substantial missing methodological details or unclear relevance to the core themes (interoperability, institutional coordination, and accountability) were excluded during the full-text screening stage in line with the PRISMA protocol. Finally, sensitivity to missing data was maintained during synthesis by transparently reporting gaps and ensuring that conclusions were drawn only from sufficiently supported evidence, thereby minimizing bias and enhancing the credibility of the review findings.

RESULTS

This review gathered evidence from the reviewed studies examining how Immigration Information Systems are integrated across jurisdictions. Particular emphasis was put on interoperability, institutional coordination and accountability. The findings have been presented according to the three research questions that guided the review.

RQ 1: How can immigration information systems achieve interoperability, including technological, semantic and organizational dimensions across different countries?

Interoperability of Immigration Information Systems

The findings confirm that interoperability is a multi-dimensional construct encompassing technological, semantic and organizational layers. This rule out the ideas that interoperability is a mere technical connectivity (Berg, 2024). Effective integration of IIS therefore requires simultaneous alignment across all the three dimensions.

Technological Interoperability

Findings from the majority of all the reviewed studies identify technological interoperability as the most developed of all the three dimensions. Common approaches include APIs, service-oriented architectures, standardized data formats (XML/JSON), web services together with biometric identification systems (Yildiz & Küpper, 2025). Centralized or shared databases were found to be used by many countries to enable fast and immediate information exchange among border control, visa applications as well as law enforcement systems. However, the implementation was found to remain uneven: While some jurisdictions rely on centralized or broker-based models, others use fragmented point-to-point integrations (European Border and Coast Guard Agency, 2021). This architectural disparity therefore tends to affect scalability, reliability and system resilience.

Semantic Interoperability

Basing on the findings from the reviews, semantic interoperability remains a persistent weakness. Although systems were found to exchange data electronically, it was found out that inconsistent definitions, incompatible taxonomies and lack of shared metadata standards undermine effective use of shared information (Vogt *et al.*, 2024). Again, immigration variables such as visa categories or enforcement outcomes are often defined differently across agencies or countries. This in turn results to the misinterpretation and poor quality of data (Nsaghurwe *et al.*, 2021). It can be concluded therefore that, without

harmonized data models and validation rules, technical connectivity does not translate into meaningful interoperability. This may eventually result to duplication, delays and reduced analytical values (Paiva & Gonçalves, 2023).

Organizational Interoperability

Further findings from the literature review show that organizational interoperability is the least mature dimension. In relation to this, the integration of IIS has been shown to be constrained by institutional silos, legacy procedures and agency-specific mandates even where technical links exist (Ibor *et al.*, 2023). Misaligned workflows, unclear responsibilities and weak governance frameworks have been further found to limit integration effectiveness (European Commission, 2023). Overall, the findings suggest that while technological interoperability is necessary, it is insufficient on its own. Table 5.1 summarizes Organizational Interoperability of Immigration Information Systems.

Table 1. *Organizational Interoperability of Immigration Information Systems*

Interoperability Dimension	Key Characteristics	Typical Challenges Identified	Representative Studies
Technological Interoperability	APIs, XML/JSON, web services, biometrics, SOA, centralized or broker-based platforms	scalability issues, Uneven architectures & system fragility	European Commission (2023); Yildiz & Küpper (2025)
Semantic Interoperability	common definitions, Shared data models, metadata standards	misinterpretation of variables, Inconsistent taxonomies & poor data quality	Berg (2024); Vogt et al., (2024)
Organizational Interoperability	MOUs, Legal frameworks (GDPR) as well as oversight bodies	Institutional silos, unclear mandates & legacy procedures	Ibor et al., (2023); Nsaghurwe et al., (2021)

Institutional Coordination and System Integration

The reviewed studies consistently highlight institutional coordination as a critical determinant of successful integration of IIS. From the literature review, four major dimensions of coordination emerged namely: interagency collaboration; governance structures; resource capacity and cross-border cooperation.

RQ2: What does institutional coordination contribute to the successful integration of immigration information systems, including interagency collaboration, governance structures, resource capacity and cross-border cooperation?

Interagency Collaboration

The findings demonstrate that interagency collaboration is essential because immigration systems involve multiple actors. These include: immigration authorities, police, border agencies, customs and foreign ministries (Ibor *et al.*, 2023). Further, the findings show that sustained integration of IIS is also associated with other formal mechanisms such as: interagency committees, shared protocols and joint system (Bozorgmehr, *et al.*, 2023). On the other hand, informal coordination often results in stalled initiatives (Nsaghurwe *et al.*, 2021).

Governance Structures

Basing on the findings from the literature review, governance structures are equally important for effective IIS integration. Clear leadership mandates, legal data-sharing, central coordinating bodies and formal MOUs have been proved to promote consistency and accountability (European Commission, 2021). On the contrary, weak or fragmented governance leads to duplication, inconsistent standards and unclear responsibilities particularly in the context of developing countries where mandate boundaries are generally unclear (Ibor *et al.*, 2023).

Resource and Capacity Constraints

It has also been evident through literature review that resource and capacity constraints including limited funding, technical expertise shortages and dependence on external vendors frequently undermine the implementation and sustainability of IIS integration (Nsaghurwe *et al.*, 2021). Vendor-driven implementations, in particular, often result to denying quality services to the general public. Such kind of proprietary systems generally limit interoperability and institutional learning (Mwikwabe, 2023).

Cross-Border Cooperation

Cross-border cooperation remains highly complex. The review found that differences in legal regimes, trust levels and technical standards constrain meaningful data sharing across countries and agencies (Ibor *et al.*, 2023). The point made here is that successful cross-border integration depends on formal agreements, shared standards and

mutual accountability mechanisms (Gregory, 2023). Figure 4 summarizes the factors influencing cross-border cooperation.

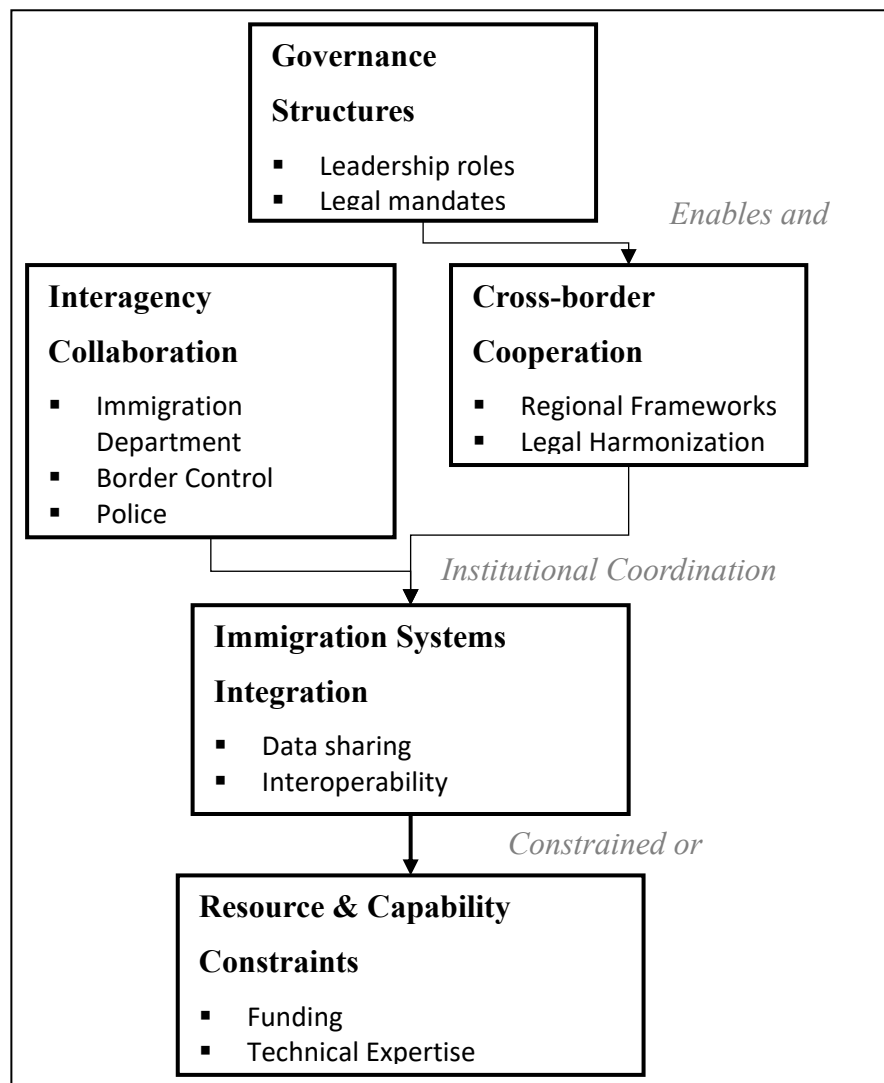


Figure 4. *Institutional Factors Influencing Immigration System Integration*

Accountability Outcomes of Integrated Immigration Systems

The reviewed literature further indicates that accountability, among other things can also be enhanced by integrated immigration information systems. Even then, these benefits are not automatic. They depend on effective system design and governance arrangements (Ibor *et al.*, 2023).

RQ3: How can an integrated immigration information system contribute to accountability through data quality, system security, transparency and user satisfaction mechanisms?

Data Quality and Integrity

Integrated systems have been found to improve data completeness and consistency. This is particularly through reducing manual processes and duplicate data entry (Vogt *et al.*, 2024). However, several studies caution that it is also possible to undermine accountability rather than strengthen it through poor semantic interoperability and weak validation mechanisms. These have the potential to propagate errors across connected systems thereby undermining accountability (Nsaghurwe *et al.*, 2021).

System Security and Privacy

Security and privacy concerns have also been found to be prominent across studies. Towards this end, it is important to note that if security controls are inadequate and weak, Integrated Immigration Systems increase exposure to cyberattacks, data leaks and unauthorized access (Ibor *et al.*, 2023). Therefore, studies emphasize the need for strong authentication mechanisms, audit trails and access control to ensure security, privacy and accountability in the system use (Costica, 2021).

Transparency and Oversight

Many studies report that integration of IIS also enhances transparency since it allows traceability of decisions, automatic logging of transactions as well as centralized reporting (European Migration Network, 2021). These features are very important for internal oversight and external auditing. However, if governance frameworks do not clearly define accountability for data accuracy, system misuse or decision outcomes, transparency advantages tend to be limited (Nsaghurwe *et al.*, 2021).

User Satisfaction and Service Delivery

Finally, literature review has found that several studies highlight improvements in user satisfaction. This is because IIS has hastened processing times, reduced duplication of requirements and improved quality service accessibility (Benton *et al.*, 2022). Nonetheless, care has to be taken to avoid factors that may cause user satisfaction to decline. For example, user satisfaction declines when systems are unreliable, poorly coordinated or perceived as intrusive underscoring the importance of balancing efficiency with accountability and trust

(Ibor *et al.*, 2023). Integrated immigration information systems and their relationships are further elaborated in Figure 5:

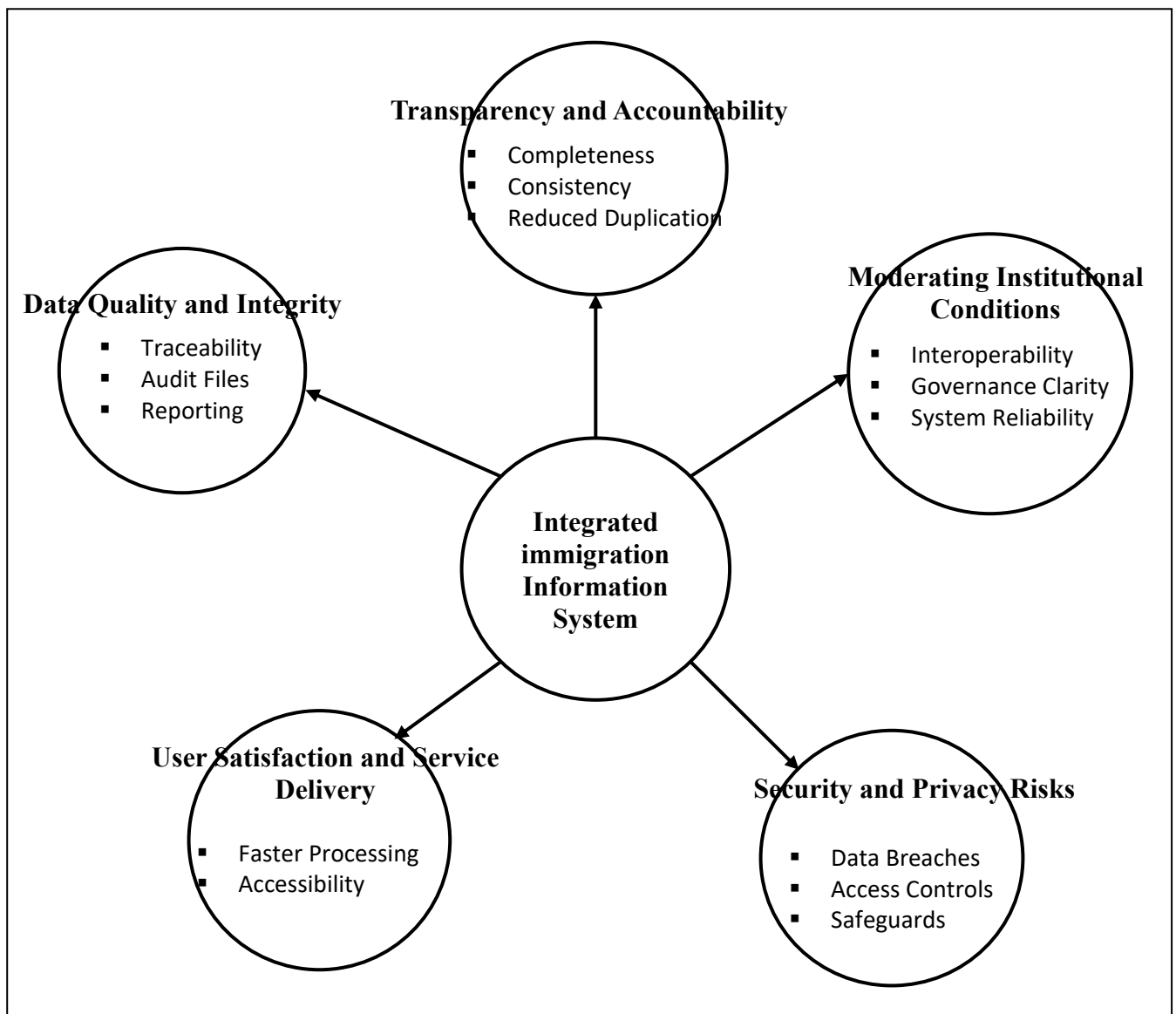


Figure 5. *Integrated immigration information systems and their relationships*

DISCUSSION

Interoperability has consistently emerged to be an essential aspect in immigration information system. It is widely known to comprise three but closely interrelated dimensions. The dimensions include: technological, semantic and organizational interoperability. These form a kind of tripartite framework on which quite an extensive research has been established (Brouwer, 2020). Further, interoperability has been proved to cover not only technical

connectivity. For example, studies examining large-scale European systems such as the Schengen Information System, Visa Information System, Eurodac and Entry/Exit System consistently maintain that interoperability includes also other dimensions such as semantic harmonization and institutional coordination (Arifin, 2020).

Technological interoperability generally emerges to be the most advanced dimension of interoperability. It facilitates the use of digital technologies such as web services, standardized biometric formats and centralized or broker-based architectures which have proved to be very important in enhancing cross-border data exchange (eu-LISA, 2022). However, further findings show significant variation across countries in terms of architectural procedures. These range from tightly coupled national identity backbones to loosely connected point-to-point integrations (World Bank, 2022). This variation has been shown to have negative impact on system performance, scalability and reliability particularly in heavily trafficked border contexts.

The semantic dimension of interoperability has been reported to consistently pose persistent challenges. According to research, although systems have been technically exchanging information, there has been inconsistent definitions of immigration status categories, risk indicators and enforcement outcomes which has undermined the effective use of shared data (UNDP, 2023). These have resulted to associated challenges such as misinterpretation, duplication and operational inefficiencies stemming from lack of harmonized data models, metadata standards and validation rules (UNHCR, 2022). It is therefore evident that technical interoperability alone does not produce meaningful integration in immigration systems. Other aspects of interoperability are also very crucial.

Then, the least developed dimension of interoperability has been identified to be the organizational interoperability (ENISA, 2023). Basing on this dimension therefore, even when effective technical links have been established, IIS integration will be constrained by other organizational factors such as divergent legal mandates, institutional silos and agency-specific procedures (World Customs Organization, 2021). Hence, coordinated organizational reforms alongside technological and semantic alignment are crucial for effective and sustainable interoperability

Therefore, institutional coordination and governance structures are also key determinants for a successful system integration. Aspects such as formal interagency collaboration, clear governance mechanisms and legally mandated data-sharing frameworks

are thus very important for a meaningful system integration (OECD, 2021). Lack of these aspects will often result to stagnated and limited operational value. Studies consistently emphasize that formal coordination mechanisms such as shared protocols, joint operational centers and collective system ownership result to more effective integration outcomes (Yildiz & Küpper, 2025).

It is therefore clear that successful integration requires strong governance structures including clearly defined leadership boundaries, central coordinating bodies and strong agreements among the participating institutions (Varastika *et al.*, 2025). On the other hand, loose or fragmented systems will eventually result in inconsistent adoption of standards, system duplication and unclear accountability in cases of system failures. Such kind of challenges have been increasingly common particularly in the developing countries where overlapping institutional mandates and limited regulatory capacity have been consistently reported further complicating integration efforts (Casagran, 2021).

Other challenges that constrain interoperability efforts and undermine system sustainability include: resource and capacity constraints, reliance on external vendors, limited funding as well as shortages of skilled personnel (Khoury & Hendow, 2025). For example, Vendor-driven and proprietary systems may deny public access to quality IIS services, restrict interoperability and reduce cross-agency information sharing. Further, cross-border cooperation challenges present additional complications. Such challenges have been reported to result to differences in national legal frameworks, technical standards and trust regimes which constrain data sharing (OECD, 2021). Thus, formal and binding agreements, harmonized governance structures and mutual advantageous accountability mechanisms are among the important requirements for a successful cross-border integration

Integrated systems have the potential to enhance decision traceability, data consistency and auditability thus ensuring system accountability (African Union, 2023). However, such benefits don't come automatically. If there are weak semantic standards, there is the likelihood of errors being spread across interconnected systems thus undermining accountability (Salgado & Beirens, 2023). Strong validation mechanisms are therefore important to ensure system accountability.

Other important concerns for the effective integrated immigration system include system security and privacy. For example, if governance and security aspects are weak, biometric databases and cross-border information may be exposed to misuse and even

cyberattacks (International Organization for Migration, 2025). This calls for strong authentication, validation procedures, access controls and audit trails so as to be able to maintain system security, privacy and accountability.

Finally, transparency concerns including standardized reporting and centralized logging are important to enhance system oversight and auditing (Brouwer, 2020). However, enjoying the benefits of transparency requires clearly assigned responsibilities for data accuracy and system use. Generally, aspects such as balanced advancement across technological, semantic and organizational dimensions are very important for effective interoperability. These need to be supported by strong governance, accountable cross-border collaboration as well as adequate resources.

CONCLUSION

Basing on the literature review, it is concluded that in the modern world, the aspect of interoperability is very crucial for the effective integration of immigration information systems. Interoperability has been shown to be a multi-dimensional issue encompassing other dimensions namely technological, semantic and organizational layers. Currently, technological interoperability through APIs, standardized data exchange formats, biometric systems and shared platforms has advanced considerably across jurisdictions including immigration information systems. However, standing alone, interoperability is not sufficient to achieve effective integration of immigration information systems. Effective and simultaneous coordination across all the three layers is needed so as to achieve sustainable interoperability.

As for Institutional Coordination, it is concluded that there need to be robust governance and coordination mechanisms for the successful integration of immigration information systems. Considerable efforts have to be made to make sure that challenges such as insufficient funding, dependence on external vendors, lack of technical expertise and other related constraints are dealt with in order to achieve sustainable, and fruitful integration outcomes

The review finally concludes that integrated immigration information systems have significant potential to enhance accountability. However, these benefits are not automatic. There are specific conditions that must be met to enjoy such benefits. There need to be clear semantic interoperability to avoid the propagation of errors across the interconnected

systems. Misinterpretations of variables and poor quality of data as a result of poor semantic interoperability have the potential to undermine the reliability of immigration data and the credibility of decision-making processes. There need also to be strong security and privacy controls to reduce the risk of unauthorized data access and misuse of the available information.

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