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# WHAT WORKS FOR EMPLOYMENT RECORDS:

## INTERNATIONAL PRACTICES & IMPLICATIONS FOR THE UNITED STATES

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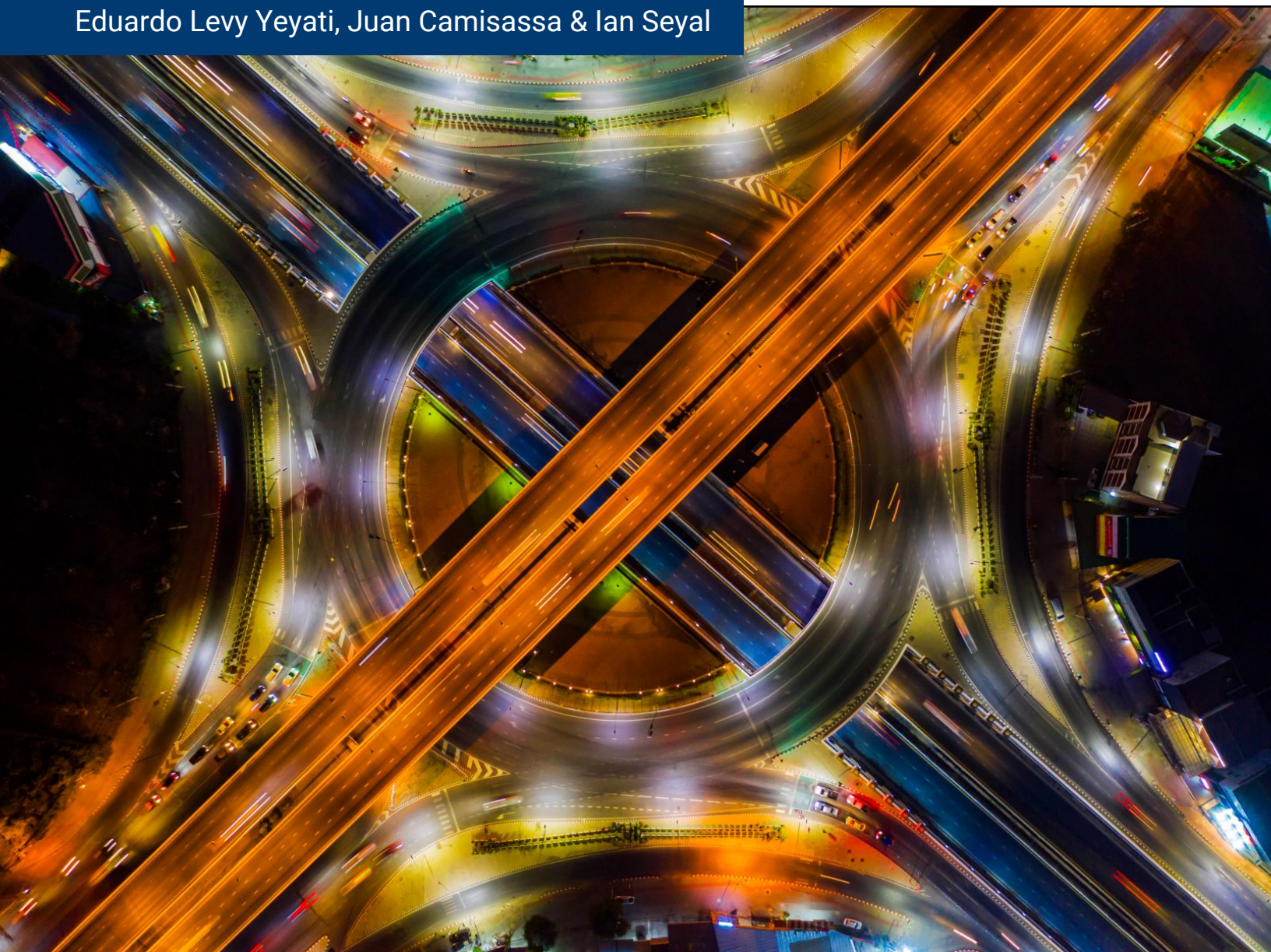

# TABLE OF CONTENTS

# TABLE OF CONTENTS

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## Disclosure

Generative AI was used as a support tool in both the research and writing phases of this report. Specifically, it assisted in (i) searching for and synthesizing information from public and official sources (such as government websites and academic publications) and drafting initial outputs, and (ii) editing text to improve clarity, conciseness, and consistency. All substantive analysis, data interpretation, and final judgments were conducted and reviewed by the authors and editors.

# 1. EXECUTIVE SUMMARY

The modernization of employment records (ERs) has become central to 21st-century labor market policy, economic mobility, and social inclusion. ERs are structured administrative data documenting an individual's employment history, including who did what, for whom, where, for how long, and with what outcomes. Around the world, peer countries have built integrated, real-time, and worker-centric ER systems that reduce administrative burden and unlock transformative insights for policy and practice.

This report benchmarks a wide range of international practices to inform U.S. stakeholders pursuing modernization efforts. While these initiatives necessarily build on the unemployment insurance wage record system, true modernization requires evolving toward a public-domain, worker-centered employment records infrastructure that serves broader economic and inclusion goals.

The United States maintains a wage records ecosystem primarily centered around state unemployment insurance (UI) systems. This system exhibits fragmentation and inconsistency across states, with limited scope and coverage that often excludes key data fields such as occupation, hours worked, work location, and employment tenure. These limitations impede labor market analysis and restrict the effectiveness of job matching, workforce training, education, and equity-focused interventions. Without occupation codes, for example, states cannot identify regional skills gaps or match training investments to employer needs. Without data on hours worked, policy evaluations of workforce training programs cannot distinguish between a program that lands a participant in a stable full-time job rather than precarious part-time work. The data reporting lag of six to nine months also hinders timely policy responses.

A more modern ER system will become increasingly important as artificial intelligence (AI) spreads through the economy. As routine cognitive tasks become automated through AI, verified experience—documented through comprehensive ERs—will increase in value. Workers who can demonstrate successful adaptation, problem-solving, and skill application across multiple roles and contexts will have significant advantages in an AI-augmented economy.

This report examines global practices in modernizing employment records systems, offering insights that may inform U.S. discussions.[1] Drawing on international cases—including real-time payroll integration models (U.K.'s RTI, Australia's STP), social security-linked systems (Germany IEB), tax-based employment databases (New Zealand LEED), digital labor registries (Brazil's eSocial), skills planning systems (South Africa), digital identity-enabled platforms (Estonia, India), and distributed credential frameworks (EU initiatives)—these examples show how modern systems can improve labor market transparency, reduce employer burden, and empower workers through better data. For workers, improved ER systems can streamline access to services, increase control over employment histories, and enhance career and education navigation. For business, they can reduce duplicate reporting and improve workforce planning through more precise, comprehensive, and timely labor market insights.

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[1] The report's findings are based on a comprehensive review of publicly available literature, academic research, and official government reports on employment record systems in the selected countries.

Although governance models vary, international experience shows that standards, interoperability, and institutional capacity can be achieved through different routes, from strong national coordination (as in Germany or the U.K.) to distributed architectures and trust frameworks (as in the EU).

# The Path Ahead

This report aims to complement and inform important U.S. efforts already underway, including those led by the Jobs and Employment Data Exchange (JEDx), the National Governors Association (NGA), and the National Association of State Workforce Agencies (NASWA), as well as state UI modernization initiatives.

While creating a standalone, public-domain ER platform would eventually require new federal legislation and resources, the most viable short-term path involves concerted state-led innovations supported by voluntary collaboratives and federal technical guidance. Successful international models suggest that incremental adoption of shared data standards and interoperable technology, piloted at the state or regional level, can both generate early wins and provide a scalable template for possible future national infrastructure.

Whether modernization results from state-led efforts or by way of federal legislation, the international examples described in this report elucidate common components of modern ER systems that are key to ensuring broad-based implementation. Across diverse systems, six core practices emerge.

**Key findings**

- **Set Standards Nationally, Implement Locally**: National technical standards, like those used by Germany's Federal Employment Agency, ensure consistency while preserving operational autonomy. EU systems show how common frameworks can achieve alignment across jurisdictions.

- **Pilot First, Improve Continuously:** Phased rollouts and iterative refinement (such as U.K.'s RTI) help manage complexity and build stakeholder support.

- **Build Around Unique Identifiers and Protect Privacy:** Stable, personal, and firm identifiers (India's Universal Account Number, New Zealand's tax identifiers) enable interoperability[2] and integration across systems. EU wallet standards show how interoperability can coexist with selective disclosure and privacy-by-design.[3]

- **Design for Timeliness and Reuse:** Embedding reporting in payroll flows (Australia's STP, Brazil's eSocial, Estonia's Employment Register) improves data timeliness and reduces burden. Verifiable-credential models (EU) allow information to be issued once and reused securely. Reusing records means, for example, that a single employer submission can be used across government agencies.

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[2] Interoperability is the ability of different employment data systems and agencies to connect and share standardized information seamlessly, enabling consistent, real-time, and secure exchange of employment records across jurisdictions and platforms.

[3] Privacy-by-design refers to an architectural approach to data systems that embeds privacy protections directly into the technical design, rather than adding them afterward. Privacy-by-design principles include data minimization (for example collecting only essential fields like earnings and occupation, not home address or reasons for absence from work) and role-based access (for example restricting researcher access only to de-identified data and restricting employer access only to their own data submissions).

- **Empower Workers Through Access and Transparency:** Tools like Brazil's Digital Labor Card enable individuals to verify employment histories, boosting data quality and trust.

- **Align Incentives, Avoid Unintended Consequences**: Policy design must consider behavioral responses, as well-meaning initiatives can create unintended consequences when incentives are misaligned. In Brazil, for example, an initiative intended to formalize self-employment inadvertently allowed employers to reduce labor costs by allowing them to misclassify employees as contractors (see Section 3.1.5.).

These lessons indicate that any approach depends on focused investments in a common architecture, shared data definitions, and the connective infrastructure needed to link data systems. Ultimately, modernizing employment records should enable every worker to securely access, verify, and share their employment history—a public good for an AI-ready economy.

# 2. THE CURRENT LANDSCAPE OF EMPLOYMENT RECORDS IN THE U.S.

This section provides an overview of U.S. employment records to contextualize how international practices can inform modernization efforts.

Though the U.S. has a rich administrative data infrastructure and a formalized labor market, it lacks a standardized system for collecting and managing employment records (see Box 1). Its system is decentralized, rooted in state-level UI reporting. Because of its origin in compliance reporting for a single program, this approach results in a landscape of siloed employment data that can be challenging to integrate across states or with other administrative records and has significant gaps in coverage for work that is not eligible for UI benefits. Consequently, the current system is inadequate to meet the needs of policymakers, workers, researchers, businesses, and educational institutions in the context of rapid economic change.

Momentum is building across states and federal agencies to modernize employment data ecosystems. This effort extends beyond IT systems upgrades to systems transformation. The rise of skills-based hiring, growing labor mobility, and the emergence of AI-driven labor market platforms all rely on timely, structured, and reliable labor market data as a basic foundation.

**BOX 1**

## Administrative Data in the United States

Administrative data encompass structured records generated through regulatory compliance, business operations, or program administration. They include UI wage reports, Internal Revenue Service (IRS) tax filings, Social Security Administration (SSA) records, and payroll vendor data. Unlike resumes or human resources (HR) files, administrative data are collected systematically according to standardized procedures and cover substantial portions of the workforce.

In the United States, most administrative employment data flows from employers to state UI wage reporting systems. The data are then transmitted to federal agencies, including the IRS, SSA, the Bureau of Labor Statistics (BLS), and the National Directory of New Hires. Because these systems were developed for different purposes and under distinct legal frameworks, they vary in scope, definitions, and accessibility.

This diversity is a result of several factors: a federated policy framework that gives states primary responsibility for records management, a wide range of systems used by employers and agencies, and deliberate limits on data sharing to protect privacy and security. Recognizing this diversity as a structural feature of the U.S. system provides important context for modernization. The challenge ahead lies in building coordination and interoperability across systems while preserving legitimate differences and privacy protections.

# 2.1 Fragmentation, Gaps, and Limitations[4]

**A Patchwork of Data Systems**

The U.S. employment record system is characterized by its decentralized nature, with data collection tied to specific public agencies. The primary source of employment records is the state-level UI wage reporting system. Originally designed to enforce employer compliance and administer UI benefits, these records are now also used for income verification and performance measurement of various public programs.

These wage records are supplemented by data from the IRS, the SSA, and other federal bodies, though the systems are not synchronized. As a result, no single system provides a complete, unified picture of employment dynamics.

UI wage records typically include worker names, Social Security numbers, employer information, and quarterly earnings. However, many key data elements such as job title, occupation code, hours worked, pay rate, worksite location, and reason for separation are either inconsistently reported or not collected at all. Only a minority of states currently gather "enhanced" wage records from employers with these additional elements, and data definitions vary, making direct comparisons difficult. The distinction of hours worked versus hours paid is an example of one significant source of confusion in data systems. Only a handful of states collect hours data. Of those that do, some report hours paid, which may include vacation, jury duty, and other paid absences, while others explicitly measure hours worked.

This landscape creates several challenges:

- **Cross-state comparisons** can be difficult to perform without a degree of error or imprecision.
- **Longitudinal tracking** of workers is limited.
- **Job quality metrics**, such as part-time status, tenure, or earnings volatility are often unavailable.
- **Nonstandard employment**, such as gig work, self-employment, and independent contracting, is largely outside the scope of these systems.

These data gaps have significant implications. They limit the granularity of labor market evaluations and make it difficult to reliably assess training and education programs. Researchers often face a cumbersome data access process, which can deter independent analysis. For workers, these limitations can create practical barriers when demonstrating transferable skills, moving between states, or accessing benefits.[5]

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[4] See Box 4.1 for distinctions between terms federated, fragmented, and decentralized.

[5] In education, students of migrant workers rely on the Migrant Student Information Exchange (MSIX) to verify grade levels when moving between schools. While MSIX supports continuity, it lacks the richer data needed to ensure an uninterrupted learning journey. On the employment side, the Wage Record Interchange System allows states to share UI wage data across state lines for evaluation purposes, but limited participation illustrates how governance and trust barriers undermine portability.

The exclusion of nonstandard workers such as freelance and gig workers, who represent a growing share of the workforce but fall outside traditional employer-employee relationships, is particularly problematic. Unlike the informal economy challenges faced by countries like Brazil or India, (see sections 3.1.5 and 3.1.7.), U.S. gig workers are often highly skilled but work through digital platforms or as independent contractors, creating a different type of coverage gap that current UI-based systems cannot address.

Even when state workforce systems hold enhanced data, they may lack the resources or legal authority to use it for broader analytical purposes, as much of the data is collected for program compliance under specific usage rules. In addition to restrictions on data usage for analytical purposes, legal restrictions are problematic for workers who want to access their verifiable employment record, which many will as the labor market increasingly values demonstrated experience. A manufacturing worker who transitions to logistics, for example, has valuable experience that may not be visible to future employers or workforce programs using wage records alone.

**Employer Burden and Compliance Friction**

Employers, particularly those operating in multiple states, face duplicative reporting requirements across various agencies. Research by the JEDx Initiative indicates that the federal government alone operates 43 workforce-related data collection programs, costing an estimated $30.1 billion in employer payroll costs annually. Multi-state employers must adapt reports to different legal definitions and timelines, which increases compliance costs and the potential for errors. This administrative burden can contribute to resistance to reporting reforms or additional data collection.

**Limited Access and Data Use**

Even when data are collected, they are not always fully utilized. Varied interpretations of essential privacy laws can limit secure data sharing for research and evaluation. The Longitudinal Employer-Household Dynamics (LEHD) program at the U.S. Census Bureau, which links UI wage records across states and with survey and administrative data, represents a valuable resource. However, access is often restricted to academic researchers through the Federal Statistical Research Data Center network.

The practical consequences of this fragmented data landscape were evident during the COVID-19 pandemic, when states and federal agencies faced difficulties identifying displaced workers and targeting support. These challenges highlight the need for more timely, granular, and accessible employment records.

BOX 2

# Barriers to Modernization in U.S. State Data Systems

Despite growing momentum for modernizing employment records, state data systems face structural and institutional challenges that affect progress and interoperability.

### Legal Fragmentation and Privacy Constraints

Each state operates under its own legal framework for data access and use, making reform complex and the process of implementing changes inefficient. Data collected for specific programs are often governed by statutes that limit cross-agency or cross-state sharing. The absence of uniform legal agreements can slow collaboration.

### Legacy IT Infrastructure

Many state systems rely on older mainframe technologies that are costly to upgrade and lack the flexibility to adopt modern reporting standards. Modernization efforts can be delayed by complex procurement processes and the challenge of replacing core systems without disrupting services.

### Lack of Standardization Across Jurisdictions

The challenge is not a complete absence of standards but disharmony across states. Data points like hours worked or occupation codes may be captured differently, if at all.[6] Open, standards-based frameworks (technical specifications that are publicly available and not controlled by any single vendor, allowing different systems to work together) can enable interoperability while allowing for local variation.

### Limited Cross-State Coordination

While multistate collaboratives are emerging, most modernization efforts remain state-specific. There is no single institutional mechanism for coordinating data architecture or pooling resources across states, which limits economies of scale and slows learning diffusion.

These factors do not preclude progress. States like Connecticut, California, Arkansas, and Alabama have demonstrated that a clear vision for digital transformation, tied to workforce and education priorities can mobilize resources and drive modernization. Moreover, multistate collaboratives like those described in the next section are increasingly influential and have improved state capacity for data modernization. These voluntary networks provide a foundation for scaling successful approaches across jurisdictions. International models also show that governance and standards can be aligned across decentralized systems, offering potential pathways for U.S.standarization efforts.

[6] See Strada's State Opportunity Index for comparison of data elements collected across states.

# 2.2 Reform Momentum: Innovations and Pilots

In response to these challenges, interest in modernizing the U.S. employment records infrastructure has grown, spurred by technological advances, federal initiatives, and promising state-level experiments.

**JEDx: A Public-Private Framework**

One of the most ambitious ongoing initiatives is the Jobs and Employment Data Exchange (JEDx), led by the U.S. Chamber of Commerce Foundation. JEDx aims to establish common data and technology standards, including a shared data model and an API-based infrastructure for data exchange. Application Programming Interfaces (API's), allow standardized communication between systems. The goal is to provide a system where employers can report data once, using shared standards, to serve multiple uses across government agencies and workforce programs.

JEDx directly addresses several key challenges:

- Reducing the employer reporting burden by standardizing reporting across jurisdictions (e.g., multi-state employers reporting UI data across states) and by consolidating duplicative requirements (e.g., consolidating state UI reports with others such as BLS).
- Improving data quality and timeliness by shifting from quarterly batch-file submissions to more frequent, standards-based reporting through API modernization.[7]
- Expanding analytics and evaluation capabilities with more granular and harmonized data.
- Empowering workers by enabling them to access and control their own verified ERs.

The vision and approach of JEDx align with many of the international practices highlighted in this report, emphasizing public-private collaboration, shared standards, and secure, interoperable technology.

**The Strada State Opportunity Index**

Strada Education Foundation and the U.S. Chamber of Commerce track the extent to which states collect "enhanced" wage record variables like job title, worksite, and hours worked. As of October 2025, 13 states collect or are developing collections for either occupation or job title, 14 collect or are developing collections for worksite location, and 17 collect or are developing collections for hours worked or pay rate. This state-by-state variation reflects the absence of a federal coordinating body, but the increasing collection of enhanced records demonstrates that progress is underway.

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[7]. JEDx is not requiring more frequent reporting but enables it based on use case requirements. JEDx tools can be deployed in states for enhancing UI alone or enhancing UI as part of consolidated reporting.

**State-Level Pilots: Alaska and South Carolina**

Two notable examples of early adoption offer insights for scaling modernization efforts:

- Alaska has collected occupation and worksite data for decades, using its Occupational Database to support detailed labor market analytics.

- South Carolina, following 2023 legislation, now requires employers with 10 or more employees to report Standard Occupational Classification (SOC) codes and total hours worked, with promising early adoption rates.

These cases show that such improvements are technically and politically feasible.

**Federal Engagement and UI Modernization**

The U.S. Department of Labor has begun offering funding and technical guidance for state UI modernization, including pilot partnerships to enhance wage data and support for IT upgrades. Additionally, the IRS and BLS have explored aligning wage reporting cycles to reduce redundancy.

While the current system remains fragmented, these innovations offer a path forward by supporting state-led development of interoperable frameworks that build on local experimentation and promote consistent data models.

The next section turns to international examples to highlight how other countries have addressed similar challenges and offer practices from which the U.S. may draw in designing a 21st-century employment records system.

**Table 1. Employment Records in the U.S.**

| Feature / Dimension | Traditional UI Wage Records | JEDx Initiative | State Efforts (Alaska, South Carolina) |
|---|---|---|---|
| **Data Coverage** | Earnings only; minimal job details | Includes occupation, job title, worksite, etc. | Adds SOC, hours worked, job location |
| **Reporting Frequency** | Quarterly | Potential for real-time (pay cycle-based) | Quarterly (with enhanced fields) |
| **Employer Reporting Burden** | High, especially for multistate firms | Designed to reduce burden via payroll APIs and standardized, consolidated reporting | Generally manageable, with state support |
| **Technology Integration** | Often legacy systems | Modern API-based architecture | Varies; South Carolina and Alaska have implemented upgrades |
| **Data Use for Workforce Planning** | Limited and delayed | Designed for real-time labor market analytics | Actively used in labor strategy and Labor Market Information (LMI) |
| **Cross-State Compatibility** | Low | Designed for national standardization | None (state-specific implementation) |
| **Privacy / Data Access** | Secure but highly restricted; varies widely by state | Designed for tiered, privacy-protected access, including distributed data access systems | Alaska publishes aggregate LMI; South Carolina restricts access under state law |
| **Inclusion of Nonstandard Work** | Excludes gig/contract workers | Exploring integration with 1099 data | Not currently addressed |
| **Data Access for Research** | Restricted, variable across states | Aims to improve access with privacy safeguards | Varies by state; Alaska offers public LMI |

# 3. GLOBAL APPROACHES AT A GLANCE

To modernize its ER infrastructure, the United States can draw on a wealth of international experience. Many countries and the European Union have implemented systems that offer potential models for standardization, integration, and technological advancement.

## 3.1 National Cases

This section benchmarks national models from eight advanced and emerging economies. To facilitate comparison, each case study is structured around four key areas:

- Context and Vision: The rationale for the reform and its primary objective.
- Reform Model: The technical and governance solution that was implemented.
- Strengths and What Worked: The key successes and positive outcomes of the reform.
- Challenges and Lessons: The obstacles encountered and the critical takeaways.

Detailed accounts of each case are available in the Annex.

### 3.1.1 UK: Real Time Information (RTI)

**Context and Vision:** The U.K. modernized its employment record system to streamline payroll reporting and enable real-time income verification for fiscal and social policy. The goal was to reduce the administrative burden on employers while providing timely, accurate data for programs like Universal Credit.

**Reform Model:** Launched in 2013, the RTI system requires employers to submit wage, tax, and pension data to HM Revenue and Customs (HMRC) with each pay cycle, replacing previous annual filings. The reform was implemented through a multiyear process involving public consultations, phased pilots, and adjustments to existing regulations.[8]

**Strengths and What Worked:** The system's success stems from its integration with existing employer payroll software, which reduces duplicate reporting and eases compliance. RTI has delivered substantial administrative savings and improved cash flow for the government. It also provides up-to-date earnings data that enables more accurate social policy implementation, such as monthly adjustments to Universal Credit payments.

[8] Universal Credit is a payment to help people with their living costs. Individuals may receive payments if they are income eligible on a low income, out of work, or unable to work.

**Challenges and Lessons:** Some challenges have persisted, particularly for small employers who report difficulty resolving data mismatches. Additionally, proposals to expand data fields to include exact hours worked have met resistance over concerns about administrative burden. The U.K. experience suggests that a gradual, phased approach, combined with early stakeholder engagement and embedding reporting into existing workflows, is critical for successful implementation.

**Table 2. U.K.'s - Real Time Information**

| Dimension | U.K.'s RTI Approach |
|---|---|
| **Pilots and iterative adoption** | Public consultations and phased pilots managed complexity and built support prior to national rollout. |
| **Reducing employer burden** | Embedded real-time reporting in payroll flows to limit duplication and lower administrative costs. |
| **Flexible legal framework** | Implemented via adjustments to existing rules rather than a full legislative overhaul. |

### 3.1.2 Germany: Integrated Employment Biographies (IEB)

**Context and Vision:** Germany has created one of the world's most comprehensive longitudinal labor market data systems. The vision was to link wage records, benefit receipt, job-search activity, and training program participation under a single unique identifier to enable precise tracking of individual labor market trajectories.

**Reform Model:** Built over decades, the IEB leverages mandatory employer reporting requirements in place since the 1970s. The system uses a spell-based data model, which captures defined periods of employment, unemployment, or program participation with exact start and end dates. Governance is centralized under the Federal Employment Agency (BA), which harmonizes data from decentralized sources using common technical protocols to ensure national comparability.

**Strengths and What Worked:** The IEB provides a detailed, daily-level view of roughly 80% of the German workforce. A universal social insurance number allows for seamless data integration across different domains. This has enabled extensive research and policy analysis, including studies on wage dynamics and the effects of training programs.

Challenges and Lessons: The success of the IEB in a federal structure demonstrates that strong national coordination and standards are key to creating a valuable national information asset. The German model also highlights the importance of investing in a robust research infrastructure with secure data access to maximize public value. Finally, it underscores the utility of common identifiers and definitions for ensuring data consistency and comparability.

Table 3. Germany – Integrated Employment Biographies

| Dimension | Germany's IEB Approach |
|---|---|
| **Centralized governance with local coordination** | The BA centrally harmonizes data from municipal systems via shared protocols to ensure national comparability. |
| **Unique identifiers for integration** | A universal social insurance number enables seamless cross-domain linkage. |
| **Longitudinal and policy analysis** | A spell-based model supports precise tracking and rigorous program evaluation. |

### 3.1.3 Australia: Single Touch Payroll (STP)

**Context and Vision:** As part of a broader tax simplification agenda, Australia sought to reduce employer reporting burdens and improve compliance by shifting from periodic filings to a real-time reporting system.

**Reform Model:** Introduced in 2018, the STP system requires employers to report wages, taxes, and retirement contributions digitally through their payroll software each time employees are paid. Implementation was phased, starting with large employers before expanding to smaller businesses. A key feature was embedding reporting directly into existing payroll workflows.

Strengths and What Worked: STP minimizes administrative duplication by making reporting an automated step in running payroll. This has led to faster detection of underpaid retirement contributions and improved the government's capacity to monitor wage trends. The system's secure API ecosystem, developed with certified payroll software providers, helps ensure data quality and security.

Challenges and Lessons: While the system has been widely adopted, small businesses initially faced challenges adapting to new digital requirements. The phased implementation, along with targeted support and a long transition window, helped mitigate these barriers. The government negotiated with payroll processing companies to provide cost-effective options for small companies, which had unexpected benefits of professionalizing smaller firms despite their initial resistance. This model demonstrates how aligning reporting obligations with existing digital infrastructure can produce timely and accurate data without creating entirely new compliance channels.

**Table 4. Australia – Single Touch Payroll**

| Dimension | Australia's STP Approach |
|---|---|
| **Real-time, integrated reporting** | Reporting is an automated step within payroll software to improve accuracy and reduce burden. |
| **Secure API architecture** | Risk-classified, regulated APIs and certified providers safeguard data quality and flows. |
| **Phased implementation strategy** | Sequenced rollout from large to small employers ensured smoother transition. |

**BOX 3**

# Insights into Implementation[9]

**Start with medium-sized businesses for smoother rollout.** Australia initially focused on large employers but discovered they had complex SAP installations that slowed adoption. Medium-sized firms already using payroll software proved the ideal starting point, They were easier to work with than large corporations and more digitally ready than small businesses.

**Work within existing business practices, not against them.** Rather than creating a separate government portal, Australia partnered with payroll software providers to embed reporting directly into existing workflows. This reduced "red tape" and achieved higher compliance by making real-time reporting an automatic byproduct of routine payroll processing.

**Be transparent about new burdens while highlighting benefits.** The implementation team learned not to downplay the extra work required for more frequent reporting. Instead, they emphasized how the system would "level the playing field" by helping honest businesses compete against "phoenixing" companies that exploit reporting gaps to avoid taxes. This honest approach, combined with clear business benefits, ultimately won employer support.

**Build relationships with the payroll vendors**. Success required close collaboration with payroll software providers through consultation and relationship-building. The government offered incentives such as listing compliant software on their website and directing employers to these tools to create a win-win dynamic that drove market adoption.

[9] Insights are from a conversation with John Shepherd former director of Single Touch Payroll.

### 3.1.4 New Zealand: Linked Employer-Employee Database (LEED)

**Context and Vision:** New Zealand's goal was to enhance its labor market intelligence by creating a comprehensive, longitudinal view of employment dynamics, job flows, and wage trends without introducing new employer reporting requirements.

**Reform Model:** Initiated in the early 2000s, LEED was built by repurposing and integrating existing administrative data, primarily monthly payroll tax records from the Inland Revenue Department. The system links these records with firm and worker information from the national statistics office, New Zealand Statistics (Stats NZ), using stable, encrypted identifiers.

**Strengths and What Worked:** The system provides a rich dataset that links each job to both employer characteristics (e.g., industry, size) and employee demographics (e.g., age, gender), allowing for detailed analysis of employment relationships over time. A strong legal framework authorizes secure data sharing for statistical purposes, with privacy safeguarded through a national framework and secure access protocols.[10]

**Challenges and Lessons:** A primary limitation of LEED is that public data releases have a lag of approximately 14 months, which reduces the system's utility for real-time policy monitoring. The LEED model shows that a valuable national employment dataset can be constructed by reusing existing administrative data, but it also highlights a potential trade-off between data timeliness and completeness.

**Table 5. New Zealand – Linked Employer-Employee Database**

| Dimension | Australia's STP Approach |
|---|---|
| **Reusing administrative data** | Using existing tax data, avoids new reporting requirements. |
| **Robust research infrastructure** | Links employment data to worker and firm characteristics for evidence-based analysis. |
| **Institutional trust and privacy** | A neutral authority and "Five Safes"–style safeguards sustain privacy and trust. |

### 3.1.5 Brazil: Unified Digital Reporting and Informal Sector Coverage

**Context and Vision:** Brazil's employment record system was historically fragmented. At the same time, the country faced the challenge of extending social protections to its large informal workforce. The national vision evolved to address both issues through targeted digital initiatives.

[10] Known as the "Five Safes" framework, it sets out specific conditions for safe projects, safe people, safe settings, safe data, and safe outputs, with all microdata accessed in controlled environments and outputs vetted for disclosure risk.

**Reform Model:** For formal employment, the core reform was eSocial, a unified digital platform that replaced multiple legacy systems and standardized the submission of labor, tax, and social security data. For workers, the government introduced the Carteira de Trabalho Digital (CTD), a digital labor card that provides individuals with a verifiable employment history. To address the informal sector, parallel registries like the Cadastro Único were developed to map low-income households for social programs, and eSocial Doméstico was created to simplify compliance for employers of domestic workers.

**Strengths and What Worked:** eSocial has successfully streamlined employer reporting by consolidating multiple obligations into a single system. The CTD empowers workers with portable and transparent access to their official job histories, which can improve data quality and build trust. The Cadastro Único proved to be a critical tool for targeting emergency aid during the COVID-19 pandemic, while the eSocial Doméstico module offers a successful example of a tailored solution for a hard-to-reach segment of the workforce.

**Challenges and Lessons:** The Brazilian experience shows that a multipronged approach can effectively address the distinct needs of formal and informal sectors. However, it also highlights the importance of aligning incentives to avoid unintended consequences. For instance, the Micro-Empreendedor Individual (MEI) tax regime, a simplified framework intended to formalize self-employed workers, created an incentive for employers to misclassify dependent employees as independent contractors to reduce tax and social security costs. This practice of "disguised employment" leaves workers without the full legal protections and benefits afforded to formal employees, underscoring the need for careful policy design that anticipates such behavioral responses.

**Table 6. Brazil Innovations: eSocial, Carteira de Trabalho Digital, Cadastro Único**

| Dimension | Brazil's Approach |
|---|---|
| **Unified employer reporting** | eSocial consolidates tax, social security, and labor submissions in one system. |
| **Worker empowerment** | The CTD gives workers official, portable, digital employment histories. |
| **Informal sector inclusion** | Cadastro Único and eSocial Doméstico expand coverage to vulnerable and domestic workers through registries and simplified compliance. The management of the Cadastro Único is a shared responsibility between the federal government and the municipalities. |

### 3.1.6 Estonia: Employment Register

**Context and Vision:** As a leader in e-government, Estonia sought to create a single, authoritative source for employment status information to streamline public administration. The system is built on the "once-only" principle, where data is submitted a single time and then reused across government agencies.

**Reform Model:** Launched in 2014, the Employment Register requires employers to log all hires, suspensions, and separations with the Tax and Customs Board. This register is integrated with Estonia's national digital ID system and the X-Road[11] secure data exchange platform, which allows information to be shared automatically with other government services, such as health insurance and unemployment benefits.

**Strengths and What Worked:** The system's real-time integration enables entitlements and compliance actions to be triggered automatically, reducing paperwork. Workers receive automated notifications when their records are updated and can view their full employment history online, which builds trust and improves data accuracy. This model demonstrates how a distributed data infrastructure can achieve high levels of administrative efficiency.

**Challenges and Lessons:** The register does not capture wages or occupation, which restricts its utility for detailed labor market analysis. The Estonian approach shows that a modern, efficient system can be built on a foundation of secure digital identity and interoperable standards, enabling real-time data sharing across multiple agencies without requiring a single centralized database.

**Table 7. Estonia – Employment Register**

| Dimension | Estonia's Employment Register |
|---|---|
| **Distributed data infrastructure** | X-Road enables secure, real-time exchange across agencies under a once-only reporting principle. |
| **Central technical leadership** | The Tax and Customs Board manages the register; other agencies consume synchronized updates. |
| **Transparent citizen access** | Workers receive notifications and can view records via national portals, improving trust and accuracy. |

[11] The X-Road platform is an open-source, distributed data exchange layer enabling end-to-end encryption between government and private sector systems, while Estonia's national Public Key Infrastructure (PKI) provides digital signatures and certificate-based authentication for every transaction.

### 3.1.7 India: e-Shram and Employee Provident Fund Organization (EPFO)

**Context and Vision:** While India has a long-standing system for formal sector employees, a large informal workforce remained outside official records and social protections. The national vision was to extend social security and services to these previously excluded workers through new digital platforms.

**Reform Model:** India employs a two-pronged approach. For the formal sector, the Employee Provident Fund Organization (EPFO) uses a UAN to provide workers with a portable, consolidated record of their employment history. For the informal sector, the government launched the e-Shram portal in 2021, a national digital registry that allows informal and gig workers to self-register using their Aadhaar biometric ID.

**Strengths and What Worked:** The e-Shram portal has successfully registered over 300 million workers, linking them to social protection programs through a single identifier. The system is designed to lower barriers to registration for hard-to-reach populations, and the government has partnered with private gig-economy companies to onboard their workers via APIs.

**Challenges and Lessons:** Ensuring data completeness and accuracy across a vast and heterogeneous workforce relies on sustained outreach and is operationally complex. The Indian model demonstrates that it is possible to use unique, portable identifiers to unify fragmented records. It also offers a powerful example of designing a system for inclusivity by leveraging digital identity infrastructure and lowering barriers to registration.

**Table 8. India – e-Shram**

| Dimension | India's e-Shram Approach |
|---|---|
| **Inclusion of informal work** | e-Shram enables self-registration for unorganized and gig workers using biometric ID, expanding coverage. |
| **Public-private coordination** | Government collaborates with platform companies to register workers via APIs and extend protections. |
| **Social protection integration** | The registry links workers to multiple programs through a single universal identifier. |

### 3.1.8 South Africa: Skills Planning through the Unemployment Insurance Fund (UIF) and Sector Education and Training Authorities (SETAs)

**Context and Vision:** In response to persistent skills mismatches and high unemployment, South Africa's goal was to better connect employment records to its national workforce and skills planning efforts.

**Reform Model:** The system is based on data from the UIF, which covers most formal employment. This information is supplemented by employer-submitted Workplace Skills Plans (WSPs) and Annual Training Reports, which are collected by SETAs to help identify skills gaps. Employers submit these reports to reclaim up to 20% of a government mandated skills levy which funds training programs. In 2024, the government launched a new national Labor Market Information System (LMIS) to integrate data from the UIF and training reports.[12]

**Strengths and What Worked:** The system has the potential to create a link between wage data and strategic skills planning by connecting employment records to sector-specific training needs. The new LMIS is intended to serve as a central hub for labor market intelligence, providing timely and harmonized indicators to policymakers and training providers.

**Challenges and Lessons:** The South African experience highlights the importance of aligning incentives with data quality goals. Employers treat SETA submission primarily as a funding and compliance exercise, and grant funding is tied to accredited training programs that already exist. As a result, they report skills shortages aligned with existing training capacity rather than forward-looking needs, and the resulting data may not accurately reflect true skills gaps. Instead, the resulting data simply reflects current training capacity. This case offers a valuable lesson on the need for careful system design that encourages accurate reporting.

**Table 9. South Africa**

| Dimension | India's e-Shram Approach |
|---|---|
| Data linkage for planning | UIF employment data are combined with sectoral training reports to inform skills strategies. |
| Incentive risks | Compliance and funding driven reporting can skew signals toward current training capacity, affecting accuracy. |
| Unified LMIS | A new national system integrates surveys, taxes, and benefits to deliver harmonized labor indicators. |

[12] The LMIS applies the Statistical Data and Metadata eXchange (SDMX) standard, an ISO-endorsed specification for exchanging statistical data and metadata between organizations, enabling interoperability with other national and international statistical systems.

**Table 10. National Cases Comparison**

| Country | Frequency / Timeliness | Employer burden | Worker access / Empowerment | Worker Access / Empowerment | Governance model |
|---|---|---|---|---|---|
| U.K. (RTI) | Real-time | Higher at rollout, after low after implementation | Workers may access employment history; improved benefit accuracy though real-time data | Centralized (HMRC) | No, only formal workers |
| Germany (IEB) | Annual employer reporting; resulting data has daily granularity | Low/stable | No direct worker interface; access mainly for research | Federated. centralized governance and decentralized data collection | No, only formal workers |
| Australia (STP) | Real-time | Higher at rollout, after low after implementation | Workers may access their records; data supports compliance and agencies | Centralized (Australian Taxation Office) | No, only formal workers |
| New Zealand (LEED) | Near real-time collection; 14-month lag for publication | Low/stable (reuses tax data) | No direct worker access; statistical outputs only | Centralized (Stats NZ) | No, only formal workers |
| Brazil (eSocial, CTD, CadÚnico) | Real-time (eSocial) | Higher at rollout, after low after implementation (eSocial) | Workers access employment history via the CTD app | Interministerial -Labor, Finance (eSocial); federated (CadÚnico) | Partial, via supplemental registries (CadÚnico, MEI) |
| Estonia (Employment Register) | Real-time for employment contract events (hires, separations) | Moderate (each employment contract must be declared in real time) | Workers can view their own records in the national portal | Centralized (Tax and Customs Board), with once-only principle | Partial, via business registration for the self-employed |
| India (e-Shram) | One-time self-registration (e-Shram); monthly employer reporting (EPFO) | Self-enrollment | Workers get a digital ID and can access their data | Centralized (Ministry of Labour & Employment) | Yes, through self-registration for informal workers |
| South Africa (UIF + SETAs) | Monthly | High (monthly UIF, annual training reports, and skills plans) | No direct worker access; data used for skills planning | Centralized UIF + distributed SETAs | No, only formal workers |

## 3.2 Supranational Initiatives: The European Union

The European Union's approach to digital records and identity offers valuable lessons for the United States, particularly on achieving interoperability in a fragmented governance environment. Rather than building a centralized database, the EU focused on creating a distributed, user-centric ecosystem. This model shows how diverse jurisdictions can align on shared standards while preserving local authority, a structure highly relevant to U.S. federalism.

**Context and Vision:** To support the free movement of people and skills, the EU needed to overcome the fragmentation in how its 27 member states issue and recognize identity documents and learning credentials. The goal was to empower individuals with control over their personal data while enabling seamless, cross-border verification.

- **Reform Model:** The EU's strategy is a multilayered ecosystem built on the following components:[13]

- **Legal and Policy Layer:** The EU regulation eIDAS2.0 established the legal basis for the EU Digital Identity Wallet (EUDI Wallet), a secure mobile app for citizens to store and share digital documents like ID cards, diplomas, and professional licenses. Currently in a large-scale pilot phase, it operates on principles of user control and privacy, allowing individuals to disclose only the information necessary for a specific transaction.

- **Semantic Layer:** The European Learning Model (ELM) is a data model that aims to standardize and make interoperable any learning across the EU. It is operationalized in the form of the Europass Digital Credentials (EDC), which provides the user-facing infrastructure for issuing verifiable learning and employment-related credentials, making them portable and trustworthy across borders.

- **Trust and Verification Layer:** The EU is fostering flexible, privacy-preserving approaches to verification and data exchange. Multiple infrastructures support this layer, including the European Blockchain Services Infrastructure (EBSI). EBSI is one of several possible trust backbones—a permissioned (meaning only authorized operators can join), distributed network that can serve as a trust layer for instant credential verification. Notably, EBSI transitioned to Europeum-European Digital Infrastructure Consortiem (EDIC) governance with only 11 member states participating, indicating varied adoption across the EU. Member states are choosing diverse trust infrastructures, reflecting the flexibility within the eIDAS 2.0 framework. It serves as a trust layer, allowing for the instant verification of credentials without requiring direct communication between the issuer and the verifier.

**Strengths and What Worked:** The EU model excels at creating "hard infrastructure": shared technical standards (like EDC and EBSI) and semantic vocabularies (like ELM) that enable technical interoperability across borders. This standards-based approach allows for coordination across its 27 member states without creating a single, centralized database, a structure highly relevant to U.S. federalism.

**Challenges and Lessons:** The EU has struggled more with "soft infrastructure", such as user interfaces and application formats. The standardized Europass CV, for instance, is often seen as too rigid and has faced limited private-sector adoption. This highlights a key lesson: technical interoperability does not guarantee social acceptance. In response, the EU is innovating with features like an AI-powered "Smart CV," announced in July 2025, which aims to help users create tailored, job-specific resumes from their comprehensive digital profiles.

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[13] While many other projects exist in the EU's broader digital identity landscape, these three are the most relevant for this report, as they directly address verifiable credentials and cross-border trust for employment and learning records.

# 3.3 Global Lessons

These international cases highlight several recurring principles for designing an effective employment records system. While institutional contexts differ, successful reforms share common features in their governance, technology, and design.

**Table 11: Global Innovations**

| | Key Feature |
|---|---|
| **United Kingdom** | Real-time payroll integration advanced through pilot projects |
| **Germany** | Legally mandated, social security-linked records with centralized governance and decentralized data collection |
| **Australia** | Fully digitized payroll reporting with secure APIs and a phased rollout |
| **New Zealand** | Tax-based longitudinal tracking |
| **Brazil** | Unified digital labor reporting and worker access |
| **Estonia** | Digital ID-enabled data exchange |
| **India** | Aadhaar (ID)-linked inclusion of informal workers |
| **South Africa** | Linking unemployment data with skills and employment planning |
| **Eu Initiatives** | Distributed digital ID and credentials for cross-jurisdictional worker mobility |

### 3.3.1 Set Standards Nationally, Implement Locally

The most successful systems demonstrate that national coordination and local flexibility can coexist effectively. Germany's Federal Employment Agency harmonizes data from decentralized sources using common technical protocols, ensuring national comparability while allowing local operational autonomy. Similarly, the EU's approach shows how common frameworks can achieve alignment across jurisdictions without requiring centralized control.[14]

[14] See also the Pan-Canadian Trust Framework (PCTF), a standards-based framework developed by the Digital ID & Authentication Council of Canada to enable trusted digital identity and credential exchange across federal, provincial, territorial, and private actors. Alongside pilot projects such as the Canadian Digital Credential pilots, it shows how a federated government can coordinate standards and interoperability across provinces.

Together, these examples illustrate workable strategies that may inform U.S. approaches to building a modern ER system: a nationally led model that enforces standards through a strong authority, and a standards-driven federated approach in which national actors define reference architectures and trust services while leaving states broad latitude in implementation.

### 3.3.2 Pilots First, Improve Continuously

The U.K.'s RTI system demonstrates the value of gradual implementation, built-in feedback loops, and adaptive policy design. Early-stage pilots helped identify operational challenges and refine technical processes before full deployment. Australia's STP and Brazil's eSocial followed similar approaches, moving from small cohorts to universal coverage while adjusting standards and employer interfaces.

At the supranational level, the European Union has relied on pilots and public-private partnerships to shape its digital identity and credential ecosystem. Large-scale demonstrations of the EBSI and competitions around the EUDI Wallet tested governance rules, privacy safeguards, and usability before regulation came into force.

The U.S. can draw on a phased approach, leveraging state or sector-specific pilots that are already underway. These efforts are generating momentum, with more states and sectors beginning to participate. The cases mentioned above demonstrate that this approach can be viable. Federal agencies can sponsor multistate or sector pilots to test shared data standards, wallet-style credentials, or privacy-preserving architectures, while states manage local implementation and maintain ownership of their systems and data. Iterative testing, coupled with clear guidance, can help ensure technical, legal, and user-experience challenges are resolved before broader implementation.

### 3.3.3 Build Around Unique Identifiers and Protect Privacy

A common feature across successful national systems is the use of stable, interoperable identifiers such as India's Aadhaar/UAN, Brazil's national registries, New Zealand's tax identifiers or Germany's social insurance number. These identifiers allow person- and firm-level records to be linked across time and domains (e.g., tax, employment, benefits, education), enabling powerful analysis and streamlined service delivery.

However, design choices around identifiers prove critical for maintaining trust. Systems that enable broad linkages raise concerns about privacy if implemented without safeguards. Recent work in the EUDI Wallet demonstrates how interoperability can be combined with privacy-by-design: credentials are issued in a verifiable format that supports selective disclosure, allowing individuals to prove authenticity without constant reference to a central registry.

For the U.S., a robust system may require expanded use of Social Security Numbers (SSNs) and Employer Identification Numbers (EINs) under clear privacy frameworks to support linkages across IRS, SSA, UI, and education systems. Any strategy must balance seamless integration with protection against unnecessary tracking by adopting architectures that allow verification without exposing all transactions to a central authority.

### 3.3.4 Design for Timeliness and Reuse

Modern employment record systems prioritize timeliness and efficiency by embedding data collection directly into existing business processes.

Systems like Australia's STP, Brazil's eSocial, and Estonia's Employment Register demonstrate that real-time digital reporting, when embedded into payroll processes and supported by APIs, can reduce compliance burdens and improve data quality. These systems also showcase the benefits of "once-only" reporting architectures, where employer submissions are reused across multiple agencies.

At the same time, recent European pilots around the EUDI Wallet and the EBSI illustrate a complementary approach: verifiable credentials that can be issued once and reused many times without continuous calls to a central service. This model preserves efficiency while giving individuals stronger control over when and how their data are shared.

For the U.S., combining these approaches could maximize both timeliness and privacy. Modern API-based infrastructure (like the model JEDx is advancing) can coexist with wallet-style credential exchanges, allowing employers and workers to choose the channel best suited to their needs while managing risks through clear safeguards.[15]

### 3.3.5 Empower Workers Through Access and Transparency

Brazil empowers individuals to access and verify their full employment histories through its digital labor card, while Estonia allows workers to view and confirm current employment registrations. European pilots around the EUDI Wallet aim to let individuals securely hold and present their own verifiable credentials. This transparency improves trust, supports error correction, and increases worker agency.

The U.S. could consider adopting similar tools to let individuals verify employment records and claim benefits, helping them manage career transitions. When workers can access and verify their own records, they become active participants in maintaining data accuracy rather than passive subjects of data collection.

### 3.3.6 Align Incentives, Avoid Unintended Consequences

**Experience shows incentives shape reporting quality:** In South Africa, employers can more readily access training grants when their SETA submissions list vacancies and skills gaps tied to existing SETA training programs. As a result, instead of reflecting forward-looking labor shortages, data simply reflect existing training capacity. Similarly in Brazil, the MEI regime, intended to formalize self-employed workers, became a method for employers to disguise traditional employment relationships by classifying workers as independent con-

[15] The U.S. debate on digital driver's licenses illustrates the risks associated with tracking and surveillance if not carefully designed.

tractors, thereby lowering their labor costs. As a result, workers receive thinner benefits and employment statistics are distorted.

**Similar dynamics could arise in the United States:** Platform work and other non-standard jobs may blur employment boundaries, employers may resist broader reporting requirements, and uneven enforcement across states could create reporting gaps. Modernization efforts can treat reporting accuracy as a social and governance challenge, aligning benefits, rules, and monitoring so that complete and truthful submissions become the most rational choice.

# 4. DESIGNING A STANDARD AND COMPARABLE EMPLOYMENT RECORDS SYSTEM

Modernizing the U.S. ER infrastructure offers an opportunity to create value for employers, workers, and government. International experience provides a range of models for strengthening ER systems. For example, the real-time payroll systems in the U.K. and Australia reduce reporting burdens, Germany's longitudinal database supports high-quality labor market research, and India's digital registry expands access to social benefits.

International experiences offer valuable lessons, not only in their successes but also in their challenges, which include operational hurdles (U.K.), incentive misalignment (South Africa), and unintended policy consequences (Brazil).

Drawing on these insights, this section outlines practical pathways for modernization aligned with U.S. policy priorities and ongoing initiatives such as JEDx and state-led pilots. The goal is to identify building blocks for an interoperable, privacy-preserving system that streamlines employer reporting, empowers workers with portable histories, and advances more effective public policy.

**BOX 4.1**

## Defining Terms: Governance Structures versus System Design Choices

**Fragmentation** refers to the lack of coordination across governance structure. Federated describes coordinated state and local governing authority operating under a shared framework.

Centralized governance means a single authority sets rules and integrates data. Distributed architecture describes technical system design patterns where data stays with holders and moves via standards and APIs, often enabled by cloud services and trust frameworks.

Decentralized system design characterizes technical architectures in which no single node controls data flow.

While "decentralized" is often used in popular discourse to suggest the absence of central authority, in practice decentralized systems typically depend on shared standards, governance mechanisms, or intermediaries to ensure coordination and reliability. Making these distinctions helps avoid conflating governance structures with system design choices and provides a clearer foundation for understanding the international cases discussed later in this report.

# 4.1 From UI Modernization to a Public-Domain Employment Records System

International experiences point to the viability and value of a hybrid pathway for the United States, a realistic option given where momentum exists and ambitious in its aim for more comprehensive, federally legislated reform. Near-term state-led progress can lay the technical and governance groundwork for a national, public-domain employment records infrastructure.

**State led innovation pathway**

The most viable short-term path involves concerted state-led innovation—supported by voluntary collaboratives and federal technical guidance. States are already piloting enhanced records and interoperability through multistate collaboratives such as the NGA, NASWA, and initiatives like JEDx. Alaska's decades-long collection of occupation and worksite data and South Carolina's recent SOC and hours reporting demonstrate that incremental, feasible upgrades can strengthen workforce planning and analytics without overburdening employers.

This pathway leverages existing infrastructure and legal frameworks while allowing states to move at different paces based on capacity and political context. JEDx provides shared specifications and APIs that enable low-friction adoption, reducing duplicative reporting, and improving data timeliness. International models—including the EU's distributed standards-based approach and Germany's federated-but-coordinated architecture—suggest that incremental adoption of shared data standards and interoperable technology, piloted at the state or regional level, can generate early wins but requires concerted action and political will to gain broad-based adoption.

**Eventual federal standards and public-domain pathway**

Creating a standalone, comprehensive public-domain employment records platform would eventually require new federal legislation, substantial resources, and sustained political commitment. Such a system would establish universal coverage, standardized data elements, and seamless cross-jurisdictional integration—moving beyond the limitations of UI-based compliance systems. Germany's Integrated Employment Biographies (IEB) illustrates how strong national coordination and stable identifiers support longitudinal data analysis.

A longer-term vision for the U.S. does not require replicating any single international model but rather establishing a common architecture with shared data definitions, modern infrastructure, and collaborative governance to connect today's fragmented systems. Federal action would ultimately define baseline specifications, privacy guidance, and funding incentives, while leaving delivery flexibility to states.

**An Individual-Centered Hybrid Pathway**

One viable approach for the U.S. is a hybrid pathway that sequences state-led innovation and federal standard-setting around a central organizing principle: empowering the individual. In the American context, with

its emphasis on individual privacy, economic liberty, and a federated governance structure, a successful modernization effort must demonstrate clear, tangible benefits for workers and employers first. Doing so is the most effective strategy to build the broad-based political will required for eventual federal action and the creation of a true public-domain system.

In a worker-centered model, individuals gain secure, portable access to their verified employment histories through digital wallets or similar tools. International experience—particularly from Brazil's Digital Labor Card (CTD), the European Union's digital wallet initiatives, and Estonia's X-Road platform—demonstrates that worker-centered systems can drive adoption, improve data quality, and create demand for broader modernization.

In the U.S. context, this approach could sequence as follows:

- **Short-term: Continue State-Led, Individual-Focused Pilots**
  The near-term focus remains on voluntary state efforts and multi-state collaboratives, building on existing UI systems while perhaps piloting worker access portals and adding verifiable credential capabilities.

- **Medium-term**
  Ensure that workers and employers in pilot states begin to benefit from portable, verified records with streamlined reporting. Ideally workers can easily access and use records. With federal action on the horizon, engage in a collaborative governance model to improve systems, data categories and collection systems.

- **Medium to Long-term**
  A Public-Domain System Built on Individual Consent: The goal remains a comprehensive, public-domain system, but one designed around the principle of individual control. Federal legislation, when it becomes politically feasible, would not create a monolithic government database. Instead, it would establish the "rules of the road": mandating open standards and APIs, setting baseline privacy and security requirements, and establishing governance for a distributed network.

This approach aligns with U.S. context—and values—and leverages the most successful aspects of international systems, making it the most promising path toward a modern ER system in the United States.

## 4.2 Defining Core Employment Data Standards

A shared core data specification enables comparability and portability across states and agencies. The goal is interoperability rather than uniformity so records link across systems. Building on JEDx proposals and international lessons, the following illustrative fields reflect what many systems already capture or are moving toward, balancing utility for workforce policy with feasible reporting.

**Table 12. Illustrative Core Data Elements**

| Feature / Dimension | Traditional UI Wage Records | JEDx Initiative |
|---|---|---|
| **Worker Identity** | Name, Social Security number (or Taxpayer ID), Date of Birth | Unique identification; demographic analysis |
| **Employment Details** | Employer Name[16] & EIN, Job Title, Occupation Code, Industry Code | Classify jobs and sectors; inform LMI and workforce strategy |
| **Earnings & Benefits** | Hourly Wage, Total Compensation, Bonuses, Benefits, Hours Worked | Measure job quality, wage dynamics, and labor standards |
| **Work Location & Status** | Primary Worksite Address, Remote/Hybrid Flag, Part-time/ Full-time Indicator | Regional workforce planning; commuting trends |
| **Job Tenure** | Start Date, End Date, Reason for Leaving | Turnover analysis; UI eligibility; mobility tracking |

These elements align with international benchmarks: Germany's IEB maintains daily-granular wages, tenure, and job type for comprehensive longitudinal analysis, and New Zealand's LEED links payroll tax data to firm and person characteristics to track flows, transitions, and wage growth. Final composition should be refined through dialogue with states, employers, and worker advocates, using open formats (analogous to the EU's ELM) and aligning identifiers (SSN, EIN) to foster compatibility while managing reporting burden.

## 4.3 Building Interoperability Through State-Led Collaboration

International models like the EU's distributed architecture show that alignment can be achieved through shared standards and mutual recognition, a strategy that resonates with the U.S. governance context and existing multistate data collaboratives. The U.K.'s phased rollout of its RTI system shows the value of a gradual, coordinated implementation strategy. These cases suggest a tiered framework could be adapted for the U.S. context. This section outlines how states, working together, can build the foundation for a national system from the ground up.

[16] The concept of "employer" becomes complex for gig, platform, and contract work. Some systems treat platforms as employers for reporting purposes (e.g., ride-sharing companies), while others require self-reporting by independent workers. International models vary: India enables self-registration through e-Shram; Brazil uses MEI (Microempreendedor Individual) for microentrepreneurs; Estonia links self-employed individuals through business registration. Traditional UI systems capture only W-2 employee relationships. Any U.S. framework must clarify whether and how to include 1099-contractor relationships, platform work, and self-employment in employment records.

**Table 13. A Tiered National Framework**

| Feature | Design Principle | Implementation Strategy |
|---|---|---|
| **Voluntary Core Standard** | Develop a common data specification through a multistate collaborative (e.g., NGA, NASWA) with federal technical support | States voluntarily adopt a core set of fields (job title, SOC, hours, wages, location) to enable cross-state analytics and portability. |
| **State-Level Flexibility** | Allow optional data extensions based on state needs. | States may add fields (e.g., skills, credentials) that align with their specific economic development priorities. |
| **Uniform Reporting Schedule** | Simplify filing timelines across states and agencies. | Align UI reporting with IRS payroll tax cycles. |
| **Data Linkages** | Support multistate and cross-agency analysis. | Use common identifiers (EIN, SSN) and standard formats. |
| **Federak Role as Enabler** | Federal agencies provide resources and technical guidance. | DOL, in partnership with OMB, offers model guidance, technical assistance grants, and incentives for states that adopt the core standard. |

An API-based infrastructure, like that being developed by JEDx, can provide the technical foundation for shared architecture. This approach, similar to Estonia's "once-only" principle, would allow employers to report data a single time using shared standards, with the data then securely reused for multiple authorized purposes.

Modernizing U.S. employment records ultimately requires clearer federal-state coordination on data governance, privacy frameworks, and resource allocation. International examples demonstrate that successful systems—whether centralized like Germany's IEB or federated like the EU's interoperability initiatives—depend on explicit agreements about roles, responsibilities, and shared infrastructure investment.

**Near-term Coordination Mechanisms:** In the absence of comprehensive federal legislation, coordination can advance through existing channels. The Department of Labor's UI modernization guidance can incorporate ER standards and interoperability requirements. NASWA and NGA can facilitate multistate compacts for data sharing and common standards adoption, building on existing collaboratives. These voluntary mechanisms can establish precedents and demonstrate value for eventual federal codification.

**Long-term Federal Framework:** International experience suggests that sustainable, large-scale systems eventually require federal standards, sustained funding, and clear legal authority. Germany's Social Code provides a model for how federal law can mandate data elements and reporting protocols while preserving state implementation flexibility. The EU's General Data Protection Regulation (GDPR) demonstrates

how privacy frameworks can be harmonized across jurisdictions. For the U.S., this likely means eventual legislation defining core data elements, privacy standards, and federal funding formulas for state system modernization.

**Resource and Capacity Requirements:** Current federal funding for state data systems is episodic and compliance-focused rather than capacity-building. International cases show that sustained investment in technical infrastructure, staff training, and system maintenance is essential. Germany allocates significant ongoing resources to its Federal Employment Agency for data integration and research infrastructure. The U.S. will likely need similar sustained federal investment to achieve the scale and consistency that international examples demonstrate.

## 4.4 Building a Modern Trust Framework for Privacy, Security, and Governance

A modern employment records system is not viable without a trust framework that addresses privacy, security, and governance commensurate with the scale of the challenge. The current patchwork of state-specific laws and legacy security protocols cannot manage the risks of a more integrated data ecosystem. International examples demonstrate both the complexity of this challenge and viable approaches to addressing it. Four key principles must undergird a modern trust framework:

**Governance and Legal Framework:** Privacy and security ultimately depend on governance structures with clear authority and accountability. In the near term, states can establish data collaboratives with shared privacy protocols and legal frameworks, similar to those facilitated by the NGA. Long-term success likely requires federal legislation to harmonize the fragmented legal landscape, establish clear data authorities, and provide sustained resources for security infrastructure—recognizing that modern threats require ongoing investment.

**Privacy Architecture Requirements:** The EU's GDPR and digital wallet initiatives provide models for privacy-by-design in employment data systems. Key principles include data minimization (collecting only necessary elements), purpose limitation (restricting use to defined functions), and individual control (enabling workers to access, correct, and permission their data). Estonia's X-Road platform demonstrates how these principles can coexist with administrative efficiency through selective disclosure and audit trails that make all data access visible to individuals.

**Security at Scale:** Employment data systems face sophisticated threats, as demonstrated during COVID-19 pandemic identity theft and ongoing concerns about quantum computing risks. International examples show that security requires sustained investment, not one-time fixes. Australia's STP system illustrates how API-based architectures with certified providers can manage security risks while enabling innovation. The EU's cybersecurity certification frameworks provide models for ongoing validation and threat adaptation.

**Building Public Trust:** International experience shows that transparency and individual control build trust more effectively than restricting system capabilities. Brazil's digital labor card and Estonia's citizen data por-

tal demonstrate how giving individuals visibility and control over their records can improve both data quality and public acceptance. Trust is earned through consistent performance, not promises.

BOX 4.2

## Building in Data Quality and Feedback Loops

While real-time reporting systems enhance efficiency and policy responsiveness, they also introduce risks to data integrity. The U.K.'s Real-Time Information (RTI) system, for example, faced challenges with data mismatches, particularly for small employers. Learning from such experiences, a modern U.S. system could build in data quality safeguards from the start. This would include validation protocols at the point of data entry and continuous feedback mechanisms for detection and correction.

**Recommended Features for U.S. ER Data Quality Infrastructure:**

- **Real-time error flagging and correction:** Automated prompts when entries conflict with standard formats (e.g., invalid SOC codes, duplicate dates, unreasonable hours worked).
- **Reconciliation dashboards:** Tools for employers and states to identify mismatches (e.g., between UI wage records and IRS filings) with suggested resolution workflows.
- **Audit trails and version control:** Timestamped logs tracking when records were submitted, changed, or queried, enabling dispute resolution and transparency.
- **Feedback channels for employers and states:** Secure mechanisms within payroll software or portals for clarification requests, system updates, or flagging systemic issues.
- **Integrated error monitoring:** A national helpdesk or technical assistance hub for tracking recurring data issues and supporting remediation.

Robust feedback loops ensure higher data integrity while building trust with employers, state agencies, workers, and researchers—enabling ERs to serve as reliable workforce intelligence infrastructure.

# 4.5 Digital Infrastructure

A modern employment records system should leverage digital technology to reduce administrative friction and improve timeliness. International models provide useful examples. Australia's STP system shows how reporting can be embedded into existing payroll processes, while the EU's Digital Identity Wallet pilots prioritize data portability and individual privacy.

**API-Based Architecture**

APIs provide effective routes for secure data sharing across systems. APIs enable standardized, real-time communication between systems, facilitating:

- **Automated data transfer** from payroll software to public systems
- **Real-time validation** of entries and error correction
- **Scalability for employers** of different sizes

**Employer-Facing Tools**

Supporting API adoption through digital reporting includes:

- **Self-service employer portals** for small and medium firms
- **Plug-and-play integrations** for large payroll providers (ADP, Paychex, Gusto, etc.)
- **Standard SDKs** (software development kits) for developers

In the U.S. context, states are already leading the development of APIs for employment data. New Jersey's D4AD initiative, for example, is piloting API-based reporting directly from payroll systems, demonstrating a viable path to reducing employer burden and improving data timeliness. As another example, JEDx proposes an API design supporting public-private approaches for enhanced data collection and use. This initiative serves as a transport layer for standardized data definitions, enabling near-real-time and event-driven collections. These principles align with the U.K.'s RTI experience requiring real-time payroll data submission and Australia's digitized payroll reporting through secure, risk-classified APIs.

States like Arkansas and South Carolina are piloting API-based reporting through JEDx. These state-led efforts provide the foundation for broader adoption, but scaling this approach fundamentally shifts the cybersecurity risk environment. Moving from quarterly batch-file submissions to real-time API-based exchanges creates new attack surfaces and requires sustained investment in security infrastructure, personnel training, and threat monitoring. Federal technical assistance and shared security protocols through multistate collaboratives can help states manage these risks.

**Decentralized Architecture**

Wallet-style credential systems and decentralized data frameworks allow workers to hold verified records and share them selectively, reducing surveillance concerns while fitting fragmented U.S. governance landscapes. European initiatives such as the EUDI Wallet and European Blockchain Services Infrastructure (EBSI) demonstrate how verifiable credentials enable portability and privacy without requiring continuous central calls to government servers.

## 4.6 Reducing Employer Burden through Consolidation and Incentives

**Empowering Workers with Digital Access**

Modern U.S. ER systems can provide workers direct, digital access to their verified employment histories. Brazil's CTD allows app-based access to official employment data including contracts, wages, and tenure, empowering individuals with government-certified employment profiles. Such tools enhance transparency, support job matching, and strengthen worker agency in verifying employment history for benefits or re-employment.

Employer buy-in is essential for successful modernization. The value proposition varies by employer size and type, but centers on three core benefits:

**Dramatic Reduction in Reporting Burden**

Modernization efforts benefit from minimizing administrative friction, especially for small businesses and multistate employers. The current burden includes over 40 federal surveys or data systems requiring employment reporting. Employers report similar data to IRS, DOL, SSA, and state agencies, creating redundancy that increases costs and error rates.

**Table 14. Policy Options to Reduce Burden**

| Employer Pain Point | Modernized System Solution |
|---|---|
| **Duplicative reporting to multiple agencies (IRS, SSA, state agencies)** | "Report Once, Use Many": Using an API, payroll software populates all required federal and state reports automatically. |
| **Inconsistent rules and formats across states** | Shared Data Standards: A common data specification adopted by states means employers no longer need custom reports for each jurisdiction. |
| **Manual data entry for small businesses without dedicated HR staff** | "Plug-and-Play" Integrations: Certified integrations with common small-business payroll platforms (e.g., Gusto, Paychex) make reporting an automatic background process. |
| **Delayed labor market data hindering planning and recruitment** | Real-Time Analytics: Access to aggregated, anonymized data on local skills trends and wage rates helps businesses make better hiring decisions. |

An API-based system embedded in payroll software would allow employers to report once, using standardized formats, and automatically satisfy multiple federal and state requirements.

Implementing such a system would go far beyond an upgrade to UI systems. It would be a fundamental shift from manual, duplicative, jurisdiction-specific reporting to semi-automated, standardized reporting from payroll systems. International examples demonstrate the feasibility: Australia's STP reduced employer compliance time by embedding reporting directly in payroll workflows; Brazil's eSocial consolidated eight separate reporting obligations into one digital submission.

**Better Workforce Intelligence for Internal Decisionmaking**

Enhanced employment records—with occupation codes, hours worked, skill certifications, and location data—enable employers to conduct more sophisticated workforce planning. Large employers can identify internal skill gaps, track retention patterns across facilities, and make data-driven decisions about training investments. Large companies have publicly stated their need for more timely, granular labor market data to inform hiring and retention strategies.

**Streamlined Verification Processes**

When employment records are standardized and accessible through secure APIs, background checks, credential verification, and reference-checking become faster and more reliable. This reduces hiring costs and time-to-fill, particularly for industries with high turnover or regulatory requirements for employment verification. Verifiable employment credentials, modeled on the EU Digital Wallet, could enable workers to share verified work histories directly with prospective employers, eliminating manual verification delays.

**Size-Specific Considerations**

The value proposition differs across employer types. For small businesses, policymakers may emphasize simplicity and minimal disruption. For this segment, success depends on payroll software vendors integrating standardized reporting seamlessly, with no change to employer workflows. For large multistate employers, policymakers may emphasize standardization across jurisdictions. These employers experience the greatest burden from inconsistent state requirements and stand to gain most from API-based, uniform reporting.

Platform companies and staffing agencies need systems that accommodate nontraditional employment relationships, including 1099 contractors and gig workers. Current UI systems exclude these workers entirely; a modern framework that includes nonemployee work would provide platform employers with verifiable records that support worker transitions and regulatory compliance.

**Addressing Employer Concerns**

Common employer resistance stems from concerns about data security, competitive intelligence, and additional compliance costs. These concerns are addressable. Data security risks can be managed through certified API providers, encryption standards, and tiered access controls (as demonstrated in Australia's STP). Competitive intelligence concerns can be mitigated through aggregation and de-identification protocols that allow policy analysis without exposing firm-specific strategies. Compliance costs are front-loaded (system integration) but generate ongoing savings through automated, simplified reporting. Tax credits or financial incentives may play a role in early adoption, but the core value proposition must be operational: less duplicative work, better internal data, faster hiring processes. States piloting enhanced reporting (Alaska, South Carolina, and Arkansas) should document and publicize measured time savings and error reductions to build the business case for broader adoption.

**BOX 4.3**

## The Value of Employment Records in the Time of AI: Linking Credentials and Experience to Facilitate Worker Mobility

ERs document how knowledge is applied in practice: what workers did, for whom, where, when, and with what outcomes. They capture not just job titles or wages, but also trajectories—how individuals adapt to new tasks, sectors, or technologies over time. In this sense, ERs complement rather than replace formal credentials. Traditional credentials—diplomas, licenses, certificates—signal knowledge acquisition at a point in time, while ERs offer a longitudinal account of how those capabilities were deployed in real labor market contexts.

The balance between credentials and experience is neither fixed nor uniform. Evidence suggests it varies across career stages and occupational domains. At entry, credentials often play a stronger role by assuring minimum quality standards, easing labor market matching, and certifying potential. A nursing degree or engineering license, for instance, is often a prerequisite for accessing the first job in the profession. As careers progress, however, verified experience that demonstrates adaptability, problem-solving capacity, and cross-role performance tends to carry greater weight. Longitudinal analyses of administrative data show that educational attainment is highly predictive of early labor market outcomes, but measures of accumulated experience and mobility become more salient over time.

The spread of artificial intelligence further alters this balance. Routine and entry-level tasks are most vulnerable to automation, while nonroutine, adaptive functions gain importance. Recent empirical work shows that AI adoption disproportionately affects junior roles, effectively making technological change "seniority-biased" and increasing the value of verified experience. In this setting, structured ERs become an indispensable way to recognize and reuse demonstrated capability. They can provide policymakers, employers, and workers with a verified account of adaptability across roles, reducing reliance on proxies such as pedigree or informal networks.

At the same time, credentials will continue to matter. They remain crucial for access to initial opportunities, for the regulation of licensed professions, and for signaling specialized expertise in fields where the stakes for error are high (e.g., medicine, law, aviation). In emerging sectors, new forms of credentialing (e.g., micro-credentials, industry certifications) will also coexist with experience signals.

The policy challenge is therefore to build systems that make both signals reliable and interoperable. ERs should be designed to align with credentialing frameworks, so that workers can present a holistic picture of their skills, achievements, and adaptability, and can be evaluated not only on what they once learned, but also on how they have continued to learn over time.

ERs and job matching: increasing opportunity and reducing bias Ironically, the very expansion of AI makes ER modernization more urgent. Employers, workforce agencies, and training providers increasingly use AI to match candidates with jobs, verify qualifications, and forecast skills demand. These applications depend on reliable, granular ER data that includes occupation codes, tenure, hours worked, and transitions. Without standardized records, AI systems risk amplifying existing gaps, overlooking informal experience, or reinforcing credential bias.

**ERs and job matching: increasing opportunity and reducing bias**

Ironically, the very expansion of AI makes ER modernization more urgent. Employers, workforce agencies, and training providers increasingly use AI to match candidates with jobs, verify qualifications, and forecast skills demand. These applications depend on reliable, granular ER data that includes occupation codes, tenure, hours worked, and transitions. Without standardized records, AI systems risk amplifying existing gaps, overlooking informal experience, or reinforcing credential bias.

Embedding AI into labor market systems also creates risks:

- Bias and exclusion: If ER data omit nonstandard work (gig, informal, care), AI-driven hiring could systematically disadvantage large groups of workers.
- Privacy concerns: Linking ERs to AI-enabled analytics increases the need for privacy-by-design safeguards, selective disclosure, and worker control over data use.
- Opaque decisionmaking: Without transparency, AI systems using ER data could create "black box" hiring and training recommendations, eroding trust among workers and employers.

These risks highlight the importance of aligning technical standards with governance mechanisms that ensure fairness and accountability.

For policymakers and stakeholders, AI and ERs are two sides of the same coin. Modernized ER systems are not just an administrative reform; they are a prerequisite for navigating the AI transition in ways that are inclusive and equitable. Three implications follow:

1. **Build ERs for adaptability:** Beyond recording wages and employers, systems should capture job roles, transitions, and applied skills that reflect adaptability in the face of technological change.

2. **Enable AI responsibly:** High-quality ER data improve the accuracy of AI applications in hiring and workforce planning, but safeguards must prevent bias and protect privacy.

3. **Empower workers:** Giving individuals access to and control over their verified ERs ensures that AI systems enhance, rather than diminish, worker agency.

International examples underscore this point. In Brazil, the CTD allows individuals to access verified job histories through a mobile app, giving both workers and employers confidence in recorded experience. In Germany, the IEB dataset enables longitudinal analysis that informs training policy and helps measure adaptation to technological change. In both cases, ER modernization makes it possible to harness AI responsibly while improving labor market transparency.

# 5. TAKEAWAYS: TAILORING GLOBAL LESSONS TO U.S. STAKEHOLDERS

This report finds that the path to a modern employment records system is an evolution. The central tension between improving the current UI-based system and creating a new public-domain infrastructure is best resolved through sequencing. The near-term, practical path is for states to innovate within and around the UI system through voluntary collaboratives. The longer-term, aspirational vision is for these state-led efforts to build the foundation—and the political will—for a national, public-domain data asset that exists outside of UI compliance but can serve its needs, along with many others.

International experience provides concrete lessons about both what works and what doesn't in employment records modernization. Success depends on aligning stakeholder incentives, building trust through transparency, and sequencing reforms to create positive feedback loops. Failures typically occur when systems prioritize compliance over utility, ignore employer workflow realities, or underestimate privacy and security requirements.

Below are final considerations for different stakeholders as they move toward a more modern and effective employment records system in the U.S:

- Enable coordination without centralization. International models demonstrate that national data systems can operate across decentralized environments when grounded in shared standards and technical protocols. Federal agencies can play a catalytic role by supporting interoperability across states.

- Foster innovation and partnerships. Beyond coordination, agencies can launch public-private pilots, fund innovation challenges, and publish reference architectures that vendors and states can adapt to their specific needs.

- Develop frameworks. Agencies managing core records (IRS, SSA, DOL) can adopt and publish open standards and data definitions for these systems. A clear baseline enables interoperability with states and employers while signaling that modernization focuses on building shared digital infrastructure.

- Clarify legal guidance on data use and sharing. Federal privacy frameworks can benefit from practical guidance and model agreements to help states and agencies share de-identified data securely and lawfully, avoiding overly restrictive interpretations of statutes like FERPA, SSA, and UI confidentiality laws.

- Align funding with data infrastructure goals. UI modernization and workforce innovation grants can include explicit support for shared data models, API adoption, and interagency integration — extending beyond compliance upgrades.

**For State Workforce Officials and Agencies**

- Start with defined, governed data pilots. South Carolina's 2023 legislation requiring SOC codes and hours reporting from employers with 10+ employees, and Alaska's long-standing occupational database, demonstrate manageable first steps. But technical upgrades require governance foundations. States must establish

  (1) clear statutory authority for collecting enhanced data,

  (2) explicit policies on whether data serve only UI compliance or broader analytics purposes,

  (3) frameworks defining data ownership and worker access rights, and

  (4) consent protocols for analytics uses beyond original compliance intent.

  These governance decisions—not technical capacity alone—determine whether enhanced data creates value or merely additional compliance burden.

- Invest consistently in capacity and do so in a way that enables innovation and iterative improvement. Modern systems benefit from sustained investment in people, governance, and budgeting alongside IT infrastructure. Experiences in states such as Connecticut and California show how clear data strategies and staff capacity make technical upgrades sustainable.

- Build data readiness. Adopting enhanced variables (occupation, hours worked) and standardized formats makes records usable for policy, analytics, and services while supporting broader modernization efforts.

- Explore cross-state collaboration. Regional compacts or communities of practice (e.g., NGA initiatives) can help states address common barriers—definitions, timelines, IRS/DOL interfaces—while respecting local autonomy.

- Consider national initiatives like JEDx. Shared data models and API-based reporting systems can reduce employer burden while improving access to real-time labor insights. Participating in early-stage collaboratives enhances both state capacity and influence over national standards.

**For Employers, Data Vendors, and Technology Providers**

Support open, interoperable standards to avoid vendor lock-in. Australia's certified provider approach and EU technical specifications show how standards can enable innovation while ensuring compatibility. Open standards protect long-term technology investments.

- Enable real-time, API-based reporting. As demonstrated by JEDx and international cases, embedding reporting into payroll flows offers value for compliance, workforce analytics, and credentialing tools.

- Create value responsibly. Enhanced data can support better job matching, skills-based hiring, and labor-market intelligence products while upholding privacy, security, and portability principles. However, there needs to be an infrastructure in place for independent monitoring, verification, and enforcement to develop truly interoperable data and technology.

**For Workers and Worker Representatives**

- Recognize employment records as professional assets that document valuable experience and career progression in an increasingly experience-driven economy.

- Explore opportunities to expand ER coverage to include gig work, contract positions, and non-traditional employment arrangements.

- Ensure there is adequate user-centered feedback. Worker input in designing consent rules, usability standards, and oversight helps ensure modernization serves worker needs alongside employer or government priorities.

- Engage with modernization efforts at state and federal levels that aim to better capture complete work histories and support career transitions. The goal is to ensure systems are designed around worker needs not just compliance requirements and that interfaces are accessible to workers across digital literacy level. This may include:

    (1) advocating for worker advisory boards in state UI modernization projects,

    (2) conducting user testing of worker-facing portals before full launch,

    (3) and partnering with community colleges and workforce boards to pilot employment record access tools with real workers.

**For Researchers and Evaluation Partners**

- Advocate for secure, privacy-protected access. Public research in Germany and New Zealand has benefited from structured, de-identified microdata access under strong privacy safeguards.

- Prioritize longitudinal and cross-domain linkages, built on a nonproprietary infrastructure of digital identify verification. Using stable identifiers and secure protocols to link employment records to education, training, and social services data enables more human-centered, rigorous analysis of career trajectories, program success, and policy effectiveness.

- Address evidence gaps in real time. The pandemic exposed limitations of delayed or fragmented labor data. Modern employment records systems allow researchers to produce faster, more localized insights, supporting better decisionmaking.

**Conclusions**

This report offers a pathway toward a modern ER system informed by international experience. The most viable near-term strategy is voluntary state coordination through multistate collaboratives, supported by federal technical assistance and philanthropic investment. A goal is for near-term actions to create political momentum for eventual federal legislation establishing a public-domain system. Specific near-term actions include:

- Multistate collaboratives (facilitated by NGA, NASWA, or state legislators' associations) voluntarily adopt common data standards, shared privacy protocols, and pilot API-based reporting. Philanthropy funds neutral conveners and provides technical assistance.

- State pilots demonstrate value propositions for different stakeholders: documenting time savings for employers, enabling credential-to-outcomes tracking for higher education, and improving career navigation for workers.

- Federal technical assistance (from DOL in coordination with OMB) provides model guidance, reference architectures, and incentive funding.

- Industry engagement ensures that initiatives like JEDx develop standards through transparent, accountable processes with adequate public sector input.

This proposed pathway generates proof-of-concept demonstrations and builds coalitions of supportive states and employers, laying the groundwork for the more comprehensive reform necessary for a modern ER system.

Success requires acknowledging structural barriers: misaligned incentives across stakeholders, fragmented legal frameworks, insufficient state capacity for cybersecurity and data governance, and the absence of federal data authority. International experiences demonstrate that technical and governance challenges are solvable, but sustained commitment and adequate resources—particularly for security infrastructure and state capacity-building—are nonnegotiable. Without addressing these foundational issues, a roadmap alone will not produce results.

With realistic understanding of challenges and sustained multi-stakeholder collaboration, the next generation of employment records can become a shared asset for economic opportunity, resilience, and mobility.

# ANNEX: CASE STUDIES

## United Kingdom: Real Time Information (RTI)

Since 2013, the U.K.'s RTI system has required employers to submit payroll data—including earnings, taxes, and pension contributions—to HMRC each time an employee is paid. The system integrates directly with tax collection and social benefits programs.

**Key Features:**

- Phased implementation featuring pilots and public consultation.
- Reduced administrative burden by embedding reporting into existing payroll systems.
- Integration with social welfare and pension systems.

**Policy Design and Implementation**

In 2010, HMRC began a reform to modernize its Pay As You Earn (PAYE) system by creating a real-time payroll reporting mechanism.[17] The goal was to reduce administrative burdens, improve tax accuracy, and provide immediate visibility into earnings. This timeliness was especially critical for adjusting Universal Credit payments based on income fluctuations.[18]

The system was designed with extensive public consultation, which included feedback from 187 stakeholders such as software developers, employers, and pension providers. This process led to significant design changes, including a switch from Bacs to the Government Gateway for data transmission.

Before a full rollout, HMRC conducted a phased pilot program with volunteer employers between April and November 2012. The pilot scaled from approximately 325 PAYE schemes to 1,300, and eventually to 65,000, allowing HMRC to refine operations and test software compatibility. During this phase, HMRC found that messages mandating real-time reporting as a legal requirement were most effective at encouraging adoption.

Legally, RTI was implemented by adapting existing legislation—The Income Tax (PAYE) (Amendment) Regulations 2012—not by creating an entirely new statutory framework. This flexible strategy, combined with stakeholder consultation, allowed the system to scale without a major legislative overhaul.[19]

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[17] PAYE is the U.K.'s national platform to collect income tax and National Insurance from employees.

[18] Universal Credit is a payment to help people with their living costs. Individuals may receive payments if they are income eligible, out of work, or unable to work.

[19] According to the U.K. Parliament, statutory instruments are the most common form of secondary (or delegated) legislation. The power to make a statutory instrument is set out in an Act of Parliament and nearly always conferred on a Minister of the Crown.

**Operational Architecture**

The RTI system is the backbone of the U.K.'s PAYE tax framework. Its core feature requires employers to submit detailed payroll information to HMRC every time they pay employees, replacing end-of-year filing.

RTI uses two main submission types:

- **Full Payment Submission (FPS):** The primary report sent with each pay run, containing regular payroll data.
- **Employer Payment Summary:** Used for adjustments not covered by the FPS, such as periods with no employee payments or claims for statutory entitlements.

Each submission includes standardized data fields:

- **Employer Identifiers:** PAYE and Accounts Office references.
- **Employee Details:** Full name, address, date of birth, and National Insurance number.
- **Payment Information:** Gross pay, pay date, and deductions (e.g., tax, National Insurance).
- **Work and Payment Status:** Hours worked (in bands), payment frequency, and indicators for irregular payments.
- **Benefits Flags:** Indicators for pension contributions, parental leave, and benefit adjustments.

Data is transmitted electronically via commercial payroll software or HMRC's free Basic PAYE Tools through the Government Gateway. The system is designed to minimize administrative work by aligning with an employer's internal payroll process.

**Outcomes and Ongoing Challenges**

RTI achieved near-universal adoption after its full rollout in April 2013, with 99% of employers transitioning to the system by 2017. The reform yielded significant fiscal and administrative benefits, including over £800 million in improved Exchequer cash flow, £672 million in reduced tax credit overpayments, and an annual net administrative burden reduction of over £290 million for businesses.

The system also provides crucial infrastructure for social policy, helping to detect underreported earnings and reduce fraudulent claims. RTI data is sent to the Department for Work and Pensions multiple times a day, allowing Universal Credit payments to be adjusted monthly based on current income information. This integration makes social security support more accurate and responsive.

Despite its success, the system faces persistent operational challenges. Evaluations and company feedback highlight recurring data mismatches between employer submissions and HMRC records, which are

often difficult to detect and correct. Small employers report long delays in resolving simple discrepancies. These issues reflect a tension between the system's goal of real-time accuracy and the capacity of its back-end infrastructure to handle errors and edge cases.

This tension also emerged in 2022 when HMRC proposed requiring employers to report exact hours worked instead of banded hours to improve income assessments for Universal Credit. The proposal was withdrawn in early 2025 after meeting strong resistance over administrative burden concerns, illustrating the trade-off between policy goals and operational reality.

Administrators continue to improve the system. A 2023 review led to progress in updating imputation models, improving quality assurance, and planning for future API-based data access for users. The system increasingly relies on reproducible analytical pipelines (RAPs) to enhance its data linkage capabilities for cross-departmental use while protecting privacy.

**Key Lessons**

The U.K.'s experience with RTI offers several important lessons for employment data modernization:

**Build Early Support:** RTI's success was rooted in extensive public consultations and multistage pilots that gathered iterative feedback.

**Prioritize Interoperability:** Integrating with existing PAYE and tax frameworks, rather than creating a new system, was crucial for adoption.

**Roll Out Gradually:** A phased implementation by employer size, combined with dedicated support for smaller firms, ensured a smoother transition.

**Start with a Simple Data Scope:** RTI began with a limited set of required data fields, with the system expanding cautiously based on operational experience.

**Leverage Existing Legal Frameworks:** Using existing regulations instead of pursuing a complete legislative overhaul streamlined implementation.

# Germany: Integrated Employment Biographies (IEB)

Germany's Integrated Employment Biographies, managed by the Federal Employment Agency (BA), is one of the world's most detailed employment records systems. Data collection is mandatory and linked to the nation's social insurance and pension systems.

**Key Features:**

- Contains daily data on wages, tenure, and job type (full-time, part-time, contract).
- Achieves near-universal employer compliance due to legal reporting obligations.
- Data is used for labor market analysis, pension tracking, and program evaluation.

Germany's system is distinguished by its long institutional history and legally mandated reporting obligations. The IEB originated from a national requirement, in place since 1973 in West Germany and extended to East Germany after reunification in 1991, for employers to report information for all workers covered by social security. This long-standing mandate created a rich, continuous administrative record of formal employment. Over the following decades, German employment records were expanded to include modules on benefit receipt, job search activity, and participation in labor market programs. The IEB's development provides an instructive model for countries with fragmented employment record systems, such as the United States.

The system's consolidation faced challenges. In the early 2000s, reforms like the unemployment assistance program under Social Code Book II (SGB II) led to institutional fragmentation and reporting disruptions. These issues were compounded by the reorganizatiown of SGB II institutions in 2011 and 2014, which caused data discontinuities and software mismatches as responsibilities shifted to municipal control. The Federal Employment Agency resolved these issues through standardization and coordination, implementing the XSozial-BA-SGB II protocol to harmonize data from municipal sources. This ensures national data comparability and reliability. Today, the IEB is a modular, daily-frequency system that integrates data from multiple administrative sources and serves as a global benchmark.

**IEB Structure and Granularity**

The IEB includes data on all individuals who have been in at least one of the following categories since data collection began:

- Employed subject to social insurance contributions (since 1975).
- Employed on a marginal part-time basis, or in a "mini-jobs" (since 1999).
- Received unemployment benefits under Social Code III or Social Code II (since 1975 and 2005, respectively).
- Registered as a job-seeker with the BA.
- Participated in active labor market programs, such as training or subsidized employment (since 2000).

These five data streams are merged into the IEB, enabling daily tracking of an individual's employment status.[20] Because the system is tied to social security, it excludes civil servants, the self-employed, and most students, covering approximately 80% of the German workforce.[21] Integration is technically straightforward, as all parts of

the system use the same personal social insurance number. The result is an umbrella dataset that merges records that might exist in separate silos in other countries.

While the full IEB dataset is confidential, a 2% random sample, the Sample of Integrated Labour Market Biographies (SIAB), is available for public access.[22] The SIAB contains 69 variables, including personal demographics, employment details (daily wage, occupation), and establishment characteristics (industry, total employees).[23]

All records are maintained as timestamped "spells" with exact start and end dates. This granular, timeline-based structure provides a uniquely comprehensive view of individual labor market trajectories. It allows researchers and policymakers to analyze transitions between employment and nonemployment with exceptional precision, making it highly valuable for studying pathways out of long-term unemployment or the returns on benefits and training programs.

The presence of anonymized personal and establishment identifiers also enables matched employer-employee analyses. Researchers can assess how firm characteristics like industry or location influence wage dynamics and job stability. Legally, the IEB is rooted in Germany's Social Code,[24] which mandates employer reporting, regulates unemployment insurance, and governs the decentralized delivery of benefits by municipal agencies. Despite this decentralized implementation, local agencies must transmit their data to the BA using the standardized XSozial-BA-SGB II protocol, which ensures national data integration.

The IEB is the product of a multi-stage process where data from companies and municipal agencies is transmitted to the BA, structured, and stored. The BA creates separate thematic datasets to enhance data quality before merging them to create a unified, longitudinal record. This process demonstrates the importance of standardizing both governance and technical protocols to ensure data reliability over time. IEB demonstrates that a well-governed administrative data system can simultaneously improve program delivery, enable real-time labor market monitoring, and power policy evaluation.

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20. According to Heinisch, Koenig and Otto (2019), the five data sources are: Employee History, Benefit Recipient History, Unemployment Benefit II Recipient History, Participants-in-Measures History, and the Jobseeker History. The integration of the different sources and legal changes in the notification procedures have increased the coverage of the data over the years (for example, due to changes in notification procedures, unpaid family workers have also been recorded since 1999).

21. Doctorate candidates financed by scholarships are not reported in the IEB (Heinisch, Koenig and Otto, 2019).

22. In addition to the SIAB, the Research Data Center of the BA provides access to several other data products derived from the German social security system, such as the Establishment History Panel (which contains annual information on all establishments in Germany with at least one employee subject to social security contributions) and the Linked Employer-Employee Data (which combines establishment-level data from the BHP with individual-level data from the IEB).

23. Variables include personal information: Gender, year and month of birth, nationality, marital status, number of children, level of education, level of vocational training. Information on employment, benefit receipt and job research: daily wage/benefit, occupation, occupation status and working hours, temporary agency work, reason of cancellation/termination/notification, employment status prior/after job search, level of requirement. Establishment variables: classification of economic activities, total number of employees, number of full-time/part-time employees, mean imputed wage, place of work (district).

24. SGB IV (General Rules for Social Security) provides the general legal basis for social insurance reporting, establishing the obligation for employers to report employment data for all jobs subject to social insurance contributions. SGB III (Employment Promotion) regulates unemployment insurance and active labor market programs and is administered centrally by the Federal Employment Agency (BA). (Basic Security for obseekers), introduced in 2005, created a new benefit regime for jobseekers, with more decentralized implementation.

**Key Lessons**

Germany's IEB offers several valuable lessons for modernizing fragmented employment records systems:

- **Establish Clear Legal Mandates.** The system is built on national laws that clearly define reporting obligations, data elements, and governance structures.
- **Centralize Governance, Decentralize Collection.** The BA centrally integrates data from municipalities using harmonized technical protocols. This ensures national consistency while allowing for decentralized data collection.
- **Use Common Identifiers for Linkage.** A universal social insurance number enables seamless integration of employment, benefit, and job search data.
- **Design for Long-Term Comparability.** The IEB's timestamped spell-data model allows for precise longitudinal tracking and ensures data remains comparable over time and across different domains.
- **Invest in Research Infrastructure.** Germany provides de-identified data samples (like SIAB) for public research while maintaining strict controls over access to full microdata, maximizing its public value.
- **Embed Robust Privacy Frameworks.** The IEB operates under Germany's strict Social Code privacy regulations, which separate operational and research data uses.

# Australia: Single Touch Payroll (STP)

In 2018, Australia introduced STP, which requires businesses to report wages, tax, and superannuation (retirement contributions) digitally through their payroll software with each pay cycle.

Key Features:

- Fully digitized payroll reporting.
- API-based communication between employers and the Australian Taxation Office (ATO).
- Real-time data to reduce tax fraud and simplify compliance.

Announced in 2014 as part of a tax simplification agenda and legislated in 2016, STP was implemented progressively. Voluntary reporting began in July 2017. The system became mandatory for businesses with 20 or more employees in July 2018 and was extended to smaller employers (19 or fewer employees) in July 2019.

Before implementation, a government analysis found that existing compliance processes were inefficient. Employers spent over A$2.5 billion[25] annually on often manual and fragmented Pay As You Go (PAYG)[26] withholding obligation processes, while government agencies struggled with data gaps that hindered service delivery and debt recovery. A key finding was that Australia had one of the longest delays globally between paying wages and remitting taxes. STP was proposed as a solution to embed reporting into the payroll cycle, reducing administrative burden and allowing for early intervention with noncompliant employers. The U.K.'s RTI system served as a model demonstrating the benefits of mandatory real-time reporting.

A regulatory impact assessment for small businesses found they faced high administrative burdens and systemic delays with the old system. Fragmented, paper-based reporting led to lags of up to 14 months in identifying noncompliance with superannuation contributions. STP was designed to close these gaps by aligning reporting with payroll events, which enables early detection of underpayments, a critical feature for small businesses where insolvency can make recovery difficult. A pilot with 138 small firms confirmed that most could adopt STP with minimal disruption, benefiting from streamlined processes and better data visibility.

STP Phase 2, mandatory from January 2022, expanded reporting requirements to include more granular data. Instead of a single gross figure, employers must now itemize components like paid leave, overtime, and bonuses. The expansion also requires reporting on an employee's employment basis (e.g., full-time, part-time), reason for termination, and child support deductions. These changes were designed to further reduce administrative duplication and improve the integrity of compliance monitoring.

**Operational Architecture**

The STP system is fully integrated into payroll software, allowing employers to automatically transmit payroll, tax, and superannuation data to the ATO with each pay run. This eliminates the need for separate, end-of-period filings. Data is transmitted via secure digital services using the ATO's Standard Business Reporting infrastructure. STP-enabled software must be listed on the ATO's official product register and comply with its Operational Security Framework.

Designed for minimal disruption, the system sends payroll data directly to the ATO, providing real-time validation and error feedback. Reporting is triggered automatically by the act of processing payroll, which reduces the administrative burden for employers and provides the ATO with timely, structured data for compliance monitoring.

The system's technical design relies on a regulated API ecosystem. The ATO classifies APIs based on a formal risk model as part of its Digital Service Provider OSF. The API for STP pay events is rated as "low risk" because it only permits the submission of structured data and does not return sensitive personal information. This controlled approach enhances the security and reliability of the real-time reporting system.

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[25] Using the October 2015 exchange rate (date of report), equals approximately $1.8 billion U.S. dollars.

[26] PAYG is Australia's national platform to collect income tax and is similar in purpose and function to the U.K.'s PAYE system.

**Key Lessons**

Australia's implementation of STP provides a compelling model for modernizing wage data collection:

- **Integrate reporting into payroll workflows.** STP shows that embedding real-time reporting into routine payroll operations is feasible and effective.
- **Use a regulated ecosystem of digital service providers.** The ATO certifies payroll software providers under a formal security framework and maintains a public register of compliant products.
- **Manage data flows with risk-classified APIs.** STP's API architecture uses risk levels to enable structured data submission while minimizing the exposure of sensitive personal information.
- **Adopt a phased rollout.** Australia's staged implementation, which started with large employers before expanding to small firms, allowed for manageable scaling and targeted support.
- **Consolidate data from multiple agencies.** STP reduces duplication by creating a single reporting stream for tax, benefits, and superannuation data.

# New Zealand: Linked Employer-Employee Database (LEED)

New Zealand's LEED, managed by Stats NZ, integrates payroll tax records from the Inland Revenue Department with data on labor, education, and social services.

Key Features

- Longitudinal tracking of individuals and firms.
- Captures job flows, employment transitions, and wage growth.
- Minimal reporting burden for employers.

**Origins and Purpose**

Initiated in the early 2000s, New Zealand's LEED was designed to enhance labor market intelligence by linking existing administrative records. The project began as a collaboration between Stats NZ, the former Department of Labour, and the Inland Revenue tax authority. Following a 2003 feasibility study that confirmed its technical viability, the government funded the development of the necessary data infrastructure.

LEED's core purpose is to leverage tax and business data to produce comprehensive labor market statistics and enable research on employment dynamics. The first statistics were released in 2006, with historical data compiled retroactively to 1999. The system was conceived to fill information gaps in official labor statistics and provide a richer evidence base for policy in areas such as employment, skills, and business performance.

**LEED: Merging Business and Individual Data**

LEED's technical foundation involves linking payroll tax data to statistical registers. Historically, employers submitted employee earnings and tax withholdings to Inland Revenue monthly. Since 2019, however, a "payday filing" system requires employers to report this information within two working days of each payday, significantly increasing the frequency of data collection.

Stats NZ integrates these frequent filings into a longitudinal database. Each payroll record includes the firm's unique tax identifier, which Stats NZ uses to link to its Business Register and attach firm attributes like location, industry, and size. Employees are identified by encrypted tax IDs, allowing Stats NZ to track an individual's employment and income over time without revealing their identity. The result is a longitudinal map of employer-employee relationships, where every job (defined as a unique employer-employee pair) can be observed quarterly, including start and end dates and total earnings.

**Data Governance and Privacy**

Stats NZ's Integrated Data Infrastructure (IDI) and Longitudinal Business Database (LBD) allow researchers to link de-identified tax and employment microdata with information on firms, individuals, and outcomes across domains such as education. The IDI and LBD are connected through LEED, enabling the study of employment dynamics at the person-firm level over time.

Data sharing operates under a legal framework that safeguards privacy. Section 81(4)(d) of the Tax Administration Act 1994 authorizes the Inland Revenue Department to transfer detailed data for statistical purposes. All personal tax records are transmitted securely and de-identified upon arrival at Stats NZ. Identifiers like tax ID numbers are replaced with anonymous codes, and personal details such as names and addresses are removed before analysis. Stats NZ is bound by the Statistics Act and strict confidentiality policies to prevent the identification of any individual or business.

The Statistics Act 2022 reinforced these obligations, expanding protections for data subjects and clarifying permissible uses of integrated data for research and public benefit. Stats NZ also applies the internationally recognized Five Safes Framework (Safe People, Safe Projects, Safe Settings, Safe Data, and Safe Outputs) to manage microdata access. This ensures that only accredited researchers working on approved projects in secure environments can access de-identified data under strict protocols. The administrative data is used exclusively for statistical and research outputs; it is not accessible for tax enforcement or operational decisions by other agencies. This institutional setup—a partnership between the national statistics office and the tax authority, supported by data-sharing agreements—has been fundamental to LEED's success.

**Outputs and Applications**

Stats NZ publishes quarterly statistics derived from LEED, including total jobs, worker flows (hires and separations), job flows (net job creation and destruction), job tenure, and earnings data for new and continuing jobs. These statistics offer a more dynamic view of the labor market than traditional surveys by providing data on turnover in addition to employment levels. LEED also makes it possible to measure phenomena such as multiple job-holding and the duration of employment relationships. Data is accessible through online tools like Table Builder and the InfoShare portal, which allow users to query detailed indicators and leverage the database's longitudinal structure.

Beyond headline statistics, LEED's linked microdata support in-depth policy analysis across education, welfare, and labor. A major application is evaluating education and skills outcomes by linking education records to subsequent earnings and employment. This helps inform students and policymakers about which skills are in demand and yield higher earnings.

Furthermore, LEED's comprehensive coverage of both employers and employees facilitates research on firm behavior, including job creation, worker turnover, and the effects of economic shocks. The system has enabled new measures of job churn and business dynamism, offering insights into how firms expand or contract and how workers move between jobs. It is also increasingly used to study wage-setting and job mobility, helping researchers analyze how wages respond to labor market conditions. This offers the potential to inform policies aimed at improving matching efficiency, monitoring labor market tightness, and understanding wage dynamics.

However, LEED's publication lags are substantial. For instance, statistics for the March 2024 quarter were published in May 2025, a 14-month delay. This time lag limits its utility for real-time policy monitoring, though it remains an indispensable tool for structural analysis and long-term program evaluation.

**Key Lessons**

New Zealand's experience with LEED shows how tax-based administrative data can be repurposed to generate rich labor market intelligence without imposing new burdens on employers. Five key lessons emerge:

- **Leverage existing administrative data** to build a national employment database, thereby avoiding new reporting requirements.
- **Use stable identifiers** to integrate person- and firm-level data across domains, enabling high-quality linkage.
- **Prioritize institutional trust and legal safeguards**, including a neutral, legally authorized agency to manage data integration and embedding privacy-by-design principles to maintain public confidence.

- **Enable cross-domain analysis** for evidence-based policy by integrating employment data with education and social program data.

- **Accept trade-offs between timeliness and completeness**, as the delay in data publication yields high-quality, validated information for research and analysis.

# Brazil: Unified Digital Reporting and Informal Sector Coverage

**Key Features**

- eSocial consolidates employer reporting.

- The CTD empowers workers with digital employment histories.

- Cadastro Único and eSocial Doméstico expand coverage to vulnerable and domestic workers.

Brazil's formal labor market data infrastructure rests on several key pillars:

- **Annual Social Information Report (RAIS):** Established in 1975, RAIS is a primary annual data source on formal employment in Brazil. All establishments are required to report each employee's job history, including wages, occupation, and start and end dates—from which tenure can be determined. RAIS data supports official labor statistics, policy analysis, and the administration of programs like the PIS/PASEP wage bonus and unemployment insurance. It covers both private and public sector employees. Since 2020, RAIS reporting has been largely absorbed by eSocial; companies submitting payroll data through eSocial no longer file separate RAIS returns. RAIS now functions as a statistical database populated almost exclusively by eSocial-collected data. The dataset also includes worker-level details such as education, race, and disability status, making it a rich resource for social and labor market analysis.

- **General Registry of Employed and Unemployed People (CAGED):** Created in 1965, CAGED is a monthly electronic register that records all formal job hires and dismissals under Brazil's Consolidation of Labor Laws (CLT). Employers have historically used CAGED reports to document every new hire or termination in the formal sector. In addition to tracking job creation and turnover, CAGED serves as an administrative tool for verifying employment relationships for programs like unemployment insurance. Since January 2020, eSocial has gradually replaced the CAGED system, and all companies are now required to report their employment changes through this new platform.

- **Digital Bookkeeping System of Tax, Social Security and Labor Obligations (eSocial):** Instituted by a 2014 decree, eSocial is an integrated online platform that unifies the reporting of employers' labor, social security, and tax obligations. Instead of filing separately with various agencies (such as RAIS, CAGED, Social Security, and the tax authority), employers submit all required information through eSocial in a standardized format. Phased implementation began in mid-2018, gradually including large firms, smaller businesses, domestic employers, and finally, public sector entities by 2021–2022. As of 2023, eSocial covers nearly all formal employers and has officially replaced separate RAIS and CAGED submissions for those in the system.

eSocial replaces older obligations with a unified channel, standardizing data with common identifiers for workers and firms and requiring real-time reporting of events like hires, terminations, monthly salaries, and tax withholdings. Its goals are to simplify compliance, guarantee workers' rights, and improve enforcement by increasing the quality and availability of information. By 2025, eSocial housed data on tens of millions of workers, becoming the core of Brazil's employment records infrastructure. It uses structured XML files and requires employers to report specific events as they occur, following a defined sequence. These real-time reports are validated and stored in a central national environment, enabling dynamic updates and reducing errors across agencies.

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To ensure precision and interoperability, eSocial uses standardized identifiers: employers are identified by their National Registry of Legal Entities (CNPJ), and workers by their Individual Taxpayer Registry (CPF). The system validates identity data against national tax and social security databases. Submissions are made through secure online platforms and digitally signed, ensuring data integrity and laying the foundation for coordination between ministries of labor, tax, social security, and statistics. As of 2025, eSocial stands as a technically robust, legally interoperable, and administratively unified system.

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Since its launch, eSocial has evolved from a compliance tool into a potential cornerstone of Brazil's labor market analytics. It provides real-time, event-based data, offering new levels of granularity and timeliness. Its potential lies in supporting monthly indicators of job flows, contract types, wage breakdowns, and worker demographics (including new information on gender identity, disability, and immigrant status). This en-

hanced information can help shape public policies that are better aligned with the labor market's realities. With the transition from RAIS and CAGED complete, Brazil is now positioned to leverage the full analytical potential of eSocial.

In addition, Brazil has modernized how workers access their employment records. Since 2019, the government has offered the CTD, a fully digital version of the traditional labor card. Accessible via a mobile app, the CTD consolidates official employment data, including contracts, wages, tenure, and benefits. As of May 2024, the system had over 74.3 million workers with active digital labor cards. While not used for generating aggregate statistics, the CTD gives workers personal visibility into their employment histories, contributing to better job matching and career development.

**Informal and vulnerable workers**

The Cadastro Único, Brazil's Unified Registry for Social Programs, is a nationwide database of low-income households. Created in 2001, it contains socioeconomic data for over 80 million people, underpinning programs like Bolsa Família. It serves as a bridge to the informal sector, identifying individuals who may need support. During the COVID-19 crisis, for instance, the government used Cadastro Único to distribute emergency aid. The system's strength lies in its local-level coverage, which allows for geographically targeted interventions. Management is a shared responsibility, with municipalities collecting and updating data, supported by federal financial transfers.

The MEI is a simplified legal framework introduced in 2008 to formalize low-income, self-employed workers through reduced taxation and streamlined registration. As of June 2025, over 16 million Brazilians are registered as MEIs. However, MEIs with hired workers must report through eSocial, while the majority without employees are not included in the unified system. Evaluations suggest MEI policies have boosted social security participation but have not significantly increased formal business registration. Furthermore, recent evidence reveals that 53% of MEIs are in disguised employment relationships, with the status often used to mask dependent labor arrangements.

To extend labor rights to domestic employees, the government introduced a dedicated eSocial module in 2015. eSocial Doméstico is a simple online portal where household employers can register their domestic workers and pay a single monthly tax covering all labor obligations. This system, enabled by the 2015 "Simples Doméstico" law, simplifies the formalization of domestic workers. The platform auto-calculates dues and generates one payment slip, making compliance feasible for individual employers. It also feeds data into the national eSocial database, providing visibility into a sector long hidden by informality. This initiative represents a significant step in bringing a traditionally informal workforce under the protection of formal labor law.

**Key Lessons**

Brazil's experience demonstrates how a unified digital platform can modernize employment reporting while targeted policies can expand coverage to informal sectors. However, it also underscores the critical need for careful policy design to avoid unintended consequences.

- **Unify employer reporting.** eSocial consolidates tax, social security, and labor submissions into a single, real-time digital system, replacing multiple legacy reports.

- **Empower workers.** The CTD provides workers with a portable, app-based digital wallet to access and verify their official employment histories.

- **Target inclusion of informal workers.** Specialized systems like eSocial Doméstico and the Cadastro Único registry extend coverage and social protections to domestic and other vulnerable workers.

- **Beware of misaligned incentives.** The MEI framework, while formalizing many self-employed workers, also created opportunities for disguised employment, highlighting the importance of anticipating behavioral responses to policy changes.

# Estonia: Employment Register

Estonia's e-government ecosystem, anchored by its national digital ID and the X-Road data exchange platform, integrates employment records with tax, social protection, and health systems.

**Key Features:**

- Real-time data sharing via secure APIs.

- Consent-based access protocols and encryption.

- Strong citizen trust in data governance.

Estonia's employment records system is a core component of its globally recognized e-government ecosystem, e-Estonia. Every citizen has a compulsory, state-issued digital identity (e-ID)—such as an ID card, Mobile-ID, or Smart-ID—used to access services. This e-ID is the foundation of a "once-only" data principle, where personal information is submitted a single time and then reused by multiple agencies through secure data exchanges.

The system's technical backbone is X-Road, an open-source interoperability platform that connects hundreds of public and private databases. Estonia's Employment Register, maintained by the Tax and Customs Board (ETCB), uses X-Road to automatically exchange records with other agencies.

The register's development was a cross-agency effort led by the ETCB. The project overcame operational challenges, such as reconciling conflicting rules between the Health Insurance Fund and the Employment Register, to build a system that aligns legal mandates with technical interoperability.

Functionally, the Employment Register is central to Estonia's social and labor administration, supplying data to at least five major state entities: health insurance, unemployment insurance, social/pension insurance,

labor inspection, and the tax authority. The register serves as a real-time hub linking the country's labor market, tax, health, and social security systems. For example, when an employer registers a new hire, the employee's health coverage begins without a gap; when a dismissal is recorded, the UIF can immediately begin processing a claim.

Since 2014, all employers must log each employee's contract, suspension, or termination in the register. These entries form the basis for determining social guarantees, such as health and unemployment insurance benefits. The system automatically updates insurance databases, pension records, and labor inspectorate logs, eliminating paper forms. Critically, employees receive an automated notification for each entry and can view their complete employment history in the e-Tax portal. This transparency improves data accuracy and builds user trust.

**Operational Architecture and Integration**

Estonia's employment records architecture is highly automated. Employers can submit data through the tax authority's e-service portal, a machine-to-machine API, CSV file uploads, or by SMS/phone in simple cases. All data is consolidated in the ETCB's Employment Register database.

Access is mediated through X-Road, which enforces use of national Public Key Infrastructure (PKI) certificates, mutual authentication, end-to-end encryption, and comprehensive logging for all data exchanges. All outgoing data is digitally signed and encrypted, while all incoming queries are authenticated and logged.

The register captures the following data:

- Worker's personal identification (ID code or name and date of birth)
- Start date of employment
- Type of employment (e.g., employment contract, service contract)
- Job title
- Address of workplace
- Rate of working time

However, the system does not record wages, occupation codes, education level, skills, or training credentials. These data points are stored, if at all, in separate administrative systems. This limits the register's direct utility for detailed labor market analytics or workforce planning. While its real-time coverage is exceptional, it is best understood as a streamlined administrative backbone rather than a rich analytical database.

**Key Lessons**

Estonia's employment records infrastructure shows how digital public systems can streamline labor administration, improve interagency coordination, and build user trust.

- **Build around secure digital identity and interoperability.** Estonia's national e-ID and X-Road platform enable secure, real-time data flows across public agencies.
- **Apply the "once-only" principle to reduce employer burden.** Employers register employment events a single time, and the data is reused by multiple agencies for various policy purposes.
- **Embed the system in cross-agency operations.** The register is functionally integrated into multiple domains, including health, unemployment, pensions, taxation, and labor enforcement.
- **Design for transparency and user trust.** Workers receive automatic notifications and can view their employment history online, which fosters trust and improves accuracy.

# India: e-Shram and Employee Provident Fund Organization

India's employment record and social protection system has a dual structure that historically covered formal, salaried workers while largely excluding the vast informal workforce from institutional social security. The country's Employee Provident Fund Organisation (EPFO) and e-Shram platform link employment, benefits, and financial services to workers through biometric Aadhaar IDs, aiming to expand social protections to informal and gig workers.

**Key Features:**

- Self-registration via mobile devices.
- Portable digital benefits across employment types.
- Integration of wage records with banking, insurance, and welfare.

The EPFO, established by a 1952 act, is a contributory social insurance scheme for the formal sector. It is employer-driven: establishments with 20 or more employees must register with EPFO and enroll their workers. Employers use the online Electronic Challan cum Return platform to file monthly contributions. In 2014, EPFO introduced the Universal Account Number (UAN), a 12-digit identifier that links an employee's multiple Provident Fund memberships. The UAN is portable across jobs, allowing a worker's tenure to be reconstructed by linking all formal employment spells under a single ID.

To address the gap for informal and independent workers, who constitute roughly 90% of the workforce, the Government of India launched e-Shram. This centralized digital platform was conceived during the COVID-19 crisis to extend social protection to unorganized workers. The platform aims to create an integrated system for social security, disaster preparedness, and benefit portability. Each worker's record is linked to their Aadhaar ID and a UAN, which allows them to access benefits across India.

According to the Ministry of Labour & Employment, e-Shram has five core objectives:

- Building a centralized database for policy implementation.
- Improving access to social security schemes.
- Facilitating job matching and skill development.
- Strengthening labor market resilience by integrating unorganized workers.
- Promoting financial inclusion through direct benefit transfers.

In essence, India's approach combines the long-standing EPFO system for formal employees with the new e-Shram digital registry for informal workers, signaling a policy shift toward more inclusive social protection.

**e-Shram: Inclusion of Informal Workers**

Registration on the e-Shram portal is voluntary and simple. Workers can self-register online (58%) or in person at a Common Service Center (40%). An individual provides their Aadhaar number for identity verification, along with basic personal, occupational, and bank details, and receives an e-Shram card with a UAN.

The e-Shram registry includes a heterogeneous range of workers, from agricultural laborers and construction workers to gig, platform, and domestic workers. Any individual aged 16–59 who is not a member of EPFO or the Employee State Insurance scheme and is not a regular taxpayer can register. As of June 2024, the portal had 308.7 million registrants, 54% of whom were women. The largest sectors represented were agriculture (52%), domestic services (9.4%), and construction (9%).

The portal is grounded in the mandate of the Code of Social Security to register unorganized workers. The National Informatics Centre developed and maintains the platform, with policy oversight from the central government's Ministry of Labour & Employment. State governments assist in mobilizing registrations and can use the data to design their own welfare programs.

**Digital Infrastructure and Interoperability**

The e-Shram portal is a national digital registry for informal workers built on a microservices architecture. It uses API-based integrations for Aadhaar authentication, OTP validation, and NPCI-linked banking. The portal connects with at least 12 government schemes, including pensions and insurance, via structured API exchange. It also links to employment platforms like the National Career Service and the Skill India Digital Hub (SIDH), creating a unified ecosystem for employment services, skills development, and welfare delivery.

As part of its strategy to track workforce transitions, the Ministry of Labour & Employment is integrating e-Shram with EPFO. This linkage makes it possible to detect when a worker transitions from informal to formal employment by obtaining a UAN under EPFO.

Recent policy changes also mandate the inclusion of gig and platform workers in e-Shram, building on their legal recognition in the 2020 Code of Social Security. The government is onboarding digital platform companies as "Aggregators", which are expected to register their workers and share data in the national database via dedicated APIs. To support this, the Ministry of Labour & Employment has outlined a Standard Operating Procedure for aggregators. The government has also announced that platform companies will contribute to workers' EPFO accounts, though this policy is still under development.

**Key Lessons**

India's e-Shram portal offers a model for how a large country can use digital infrastructure to bring excluded workers into official records.

- **Universal digital registry:** E-Shram shows the value of a single, inclusive registry. It was built with minimal documentation requirements (Aadhaar and bank details), allowing self-employed and informal workers to register without an employer. The system also supports offline enrollment and is multilingual.
- **Integrated social protection:** A single registration on e-Shram connects workers to a broad package of social programs, including pensions, insurance, housing, and job matching.
- **Public-private coordination:** The government is engaging with platform companies to register their workers via APIs, extending social protections to a wider group.
- **Accessible and multilingual outreach:** The platform's success was supported by a multilingual interface, mobile access, and in-person enrollment at over 250,000 service centers. Civil society and labor organizations were essential in reaching vulnerable groups.

# South Africa: Skills Planning

South Africa combines tax, employment, and training data to power its Human Resource Development Strategy, linking wage data from the UIF with skills development and education planning.

**Key Features:**

- Workforce data informs national skills strategies.
- Data is linked to sectoral training and job vacancy information.
- Cross-agency integration promotes administrative simpli|city.

South Africa has long recognized the importance of skills planning, embedding it in national frameworks from the 1990s Reconstruction and Development Programme to the current National Development Plan and Human Resource Development Strategy. Despite this, the country faces persistent skills mismatches and high unemployment—exceeding 30% overall and 60% for youth. In response, policymakers have recently sought to better link detailed employment records with workforce planning.

**Employment Records and Skills Development System**

South Africa's administrative employment data is anchored in the UIF system. Under the Unemployment Insurance Act of 2001, nearly all formal-sector employers must register with the UIF and contribute monthly payroll levies, creating a near-universal database of formal workers and wages, which is supplemented by tax records. As the custodian of detailed payroll data, the UIF registers employers and employees and collects 1% of payroll as contributions. These records have enabled new linkages to skills initiatives, such as the UIF's Labour Activation Programme, which uses the "SiyaYa" system to profile unemployed beneficiaries and match them with training opportunities.

Central to the country's skills planning is the SETA system. Established by the Skills Development Act of 1998, 21 SETAs span the economy by sector. Each SETA collects data from employers through mandatory WSPs and Annual Training Reports (ATRs). Companies with revenue over R500,000 must pay a 1% Skills Development Levy, 20% of which can be reclaimed by submitting these reports. The WSPs list training plans and hard-to-fill vacancies, which SETAs aggregate into Sector Skills Plans (SSPs) to identify skills gaps. In principle, this process should produce timely, firm-level data on needed occupations and qualifications to inform SETA grants and broader educational planning.

The skills planning system demonstrates how employer-submitted data can identify occupational shortages, but it also reveals the risks of misaligned incentives and implementation gaps. The quality and usefulness of SETA data have been criticized in academic and government reviews, which note that WSP and ATR submissions are often treated as compliance exercises rather than genuine skills audits. For example, one recent study found that SETAs tend to count hard-to-fill vacancies without systematically analyzing detailed staffing profiles. Furthermore, reporting incentives are shaped by the structure of training grants; firms may be more inclined to list shortages for which training programs already exist, distorting the picture of unmet demand. Research from Wits University indicates the reporting process is often too complex for smaller firms, leading to uneven data quality. Consequently, the system frequently functions more as a compliance tool than a forward-looking workforce planning mechanism. These institutional and incentive misalignments weaken the ability of SETAs to identify genuine skill gaps and limit the data's planning value.

To address these shortcomings, South Africa has launched broader labor market information initiatives. In 2024, the Department of Employment and Labour (DEL), in partnership with Statistics South Africa (Stats SA) and the International Labour Organization, launched the LMIS to "revolutionize how labour data is collected, analysed, and shared". The LMIS provides a "centralised, accessible repository of labour market insights" aligned with global standards. By consolidating survey, administrative, and training data, the LMIS aims to make key indicators readily available to policymakers and planners.

Built on international open-data standards, the LMIS offers a "data explorer" interface for users to query statistics, view interactive graphs, and download datasets. It is designed to improve policymaking by giving stakeholders—from government and employers to training institutions—timely, harmonized labor market

intelligence. For instance, the DEL notes the new system will generate alerts on emerging supply-demand gaps, inform training providers of unmet skills needs, and help match job seekers with opportunities.

The LMIS master plan also stresses coordination, calling for a careful data audit and capacity-building to ensure existing administrative and survey data can be linked. It lists numerous stakeholders whose collaboration is essential, including multiple government departments and trade associations. In practice, integrating UIF records, payroll data, the quarterly labor force survey, and various training-sector data remains a work in progress. The plan highlights key challenges: the inability to consolidate data from different producers, weak institutional mechanisms for aligning data systems with labor market policies, and slow progress toward a single, integrated national system. Nonetheless, the LMIS represents a major step forward. By offering a unified portal, it creates the infrastructure needed to track skills and employment in near-real time.

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**Key Lessons**

South Africa's experience offers insights into how employment records can support workforce planning but also provides cautionary lessons about institutional fragmentation and incentive misalignment. Despite a long-standing policy commitment, a levy-based funding system, and extensive administrative data, the country's skills ecosystem has struggled to deliver accurate, forward-looking information.

- **Legal mandates and funding are insufficient.** South Africa's system is backed by a national Skills Development Act and funded through a 1% payroll levy. Even with this robust legal and financial foundation, data quality and policy impact are limited. Strong governance, continuous evaluation, and institutional capacity are necessary to translate funding into effective skills intelligence.

- **Align incentives to improve data quality.** SETAs collect employer-reported data to identify skill shortages, but the reporting is often compliance-driven. When submissions are tied to grant eligibility, employers list shortages that can be funded and delivered now rather than those that reflect true skills gaps. Workforce data collection programs should be designed with incentives that reward transparency, accuracy, and responsiveness to labor market changes.

- **Build integrated data platforms.** The newly launched LMIS illustrates the value of consolidating survey, tax, benefits, and training data into a single system. This helps identify trends in employment, unemployment, and skills gaps more holistically.

- **Prioritize usability and public access.** LMIS data is available through LMIS.Stat, a public portal with data visualization tools, open downloads, and user-friendly interfaces. This approach increases transparency and empowers government, employers, researchers, and training providers alike.

- **Design systems that support smaller and nontraditional employers.** In South Africa, smaller firms and informal employers often have lower participation rates in the skills planning system, not due to unwillingness but to limited capacity or awareness. This can create blind spots in national data.

# European Union: A Supranational Initiative

To support worker and learner mobility across its 27 member states, the EU is building a federated, standards-based ecosystem for digital identity and credentials. This approach aims to overcome the historical fragmentation of national systems while preserving national sovereignty. Rather than creating a monolithic central database, the EU's strategy is built on three interlocking pillars: a legal framework (eIDAS 2.0 and the EUDI Wallet), common data and semantic standards (Europass, European Learning Model (ELM), European Digital Credentials (EDC), and European Skills, Competencies, Qualifications, and Occupations (ESCO)), and a decentralized architecture for trusted verification.

This ecosystem gives individuals a secure way to store and share their own verified credentials, from diplomas to professional licenses, using a mobile wallet. This user-centric model, governed by GDPR privacy principles, allows for selective disclosure of information and enables seamless, cross-border verification. The key components of this strategy include the EUDI Wallet, the Europass platform with its EDC, and various trust infrastructures.

**The EU Digital Identity Wallet (EUDI Wallet)**

As the cornerstone of the EU's new approach to portable and verifiable records, the EUDI Wallet is a secure and privacy-enhancing mobile application for digital identification for citizens, residents, and businesses across Europe. The wallet allows users to prove their identity and securely store and share digital documents, such as ID cards, diplomas, and professional certificates. It gives users complete control over their data, allowing them to decide what information to share and with whom.

The European Digital Identity Regulation, adopted in May 2024, mandates that EU member states offer at least one EUDI Wallet to all citizens, residents, and businesses by the end of 2026. This regulation sets common technical and governance standards to ensure cross-border interoperability. Since 2023, the EU has been testing the EUDI Wallet through multiyear, large-scale pilot projects. These pilots are consortia of hundreds of public and private organizations, co-funded by the European Commission. The most relevant pilot for this report is Digital Credentials for Europe (DC4EU), which focuses on the education and social security sectors with participation from 80 institutions in 22 EU countries, plus Norway, Ukraine, and Switzerland. It issues qualifications like university diplomas and professional licenses, as well as portable social security documents, in a wallet-compatible digital format. Across all pilots, users can receive credentials in their wallet and consent to share them with service providers or employers, who can instantly verify the digital attestations. This architecture minimizes direct data exchange between authorities, and data is stored locally on the user's wallet app.

Beyond pilots, the EU uses innovation challenges to accelerate development. For example, Germany's Federal Agency for Breakthrough Innovation (SPRIND) launched a 15-month competition to develop EUDI Wallet prototypes adapted for Germany. Similarly, a "Copyright Innovation Challenge" invites startups and experts to co-create digital rights infrastructure using Web3 technologies, serving as a model for public-private collaboration.

The wallet's security and privacy are based on a user-centric approach. This is achieved through data minimization and selective disclosure, which allows users to share only the necessary information for a transaction. To guarantee maximum privacy, the wallet uses zero-knowledge proofs—a cryptographic technique that verifies an attribute's validity (such as age) without disclosing its exact value.

Technically, the EUDI Wallet leverages the device's hardware security. A Secure Element (SE), a tamper-proof component in most smartphones, protects cryptographic keys and critical security functions. The authenticity of documents is guaranteed by verifiable credentials, which are cryptographically signed by the issuing entity to prevent forgery.

**Europass Digital: European Digital Credentials for Learning**

Acting as the EU's content layer for education and training, EDC and the ELM provide common standards and infrastructure. This allows learning records to be issued, understood, and recognized consistently across member states and to integrate smoothly with emerging tools like the EUDI Wallet.

The Europass framework supports worker mobility through standardized documentation. Launched in 2005 with common CV and diploma supplement templates, Europass was revitalized in 2020 for the digital era. It addresses the core problems of credential fragmentation and a lack of interoperability in European education and training. Before this reform, varied data practices hindered the automatic recognition of credentials and forced individuals to obtain paper translations and verifications. This made it difficult for employers in one country to interpret qualifications from another. The renewed Europass initiative is a digital infrastructure for portable, transparent, and trustworthy credentials across borders. In short, the EU created a common language for skills and credentials and a platform to issue and share verifiable digital records, reducing reliance on siloed national databases.

At its heart are the ELM data schema and the EDC infrastructure.[27] The European Commission built a full-stack system to create, issue, store, and verify digital credentials across the EU. The ELM is a comprehensive, multilingual ontology defining data fields for describing learning achievements, qualifications, and skills. Built on open standards like the W3C Verifiable Credential data model, it ensures interoperability. By mapping national and sectoral terms into one structure, the ELM enables comparability and portability. The Commission tested the ELM through pilots in member states, ensuring the model could accommodate different countries' standards (from vocational certificates in one country to university degrees in another).

Europass Digital Credentials promote cross-border recognition. Institutions use the Commission's online tools or integrate open-source libraries to create digitally signed credentials. Each credential is sealed by the issuer's digital signature to guarantee authenticity. Learners receive credentials via email or directly into their personal Europass online library. The infrastructure can also connect with the EBSI, for instance, by anchoring diploma credentials on a blockchain ledger.

[27] The Digital Credentials for Europe (DC4EU) pilot is distinct from Europass Digital Credentials. DC4EU is a temporary, large-scale pilot testing how education and social security records can be issued and verified inside the EUDI Wallet, while Europass Digital Credentials constitute the permanent EU infrastructure for issuing and validating learning achievements based on the European Learning Model.

**Hard vs. Soft Infrastructure and the "Smart CV"**

The Europass ecosystem illustrates the distinction between "hard" and "soft" infrastructure. The EU has succeeded in building the hard infrastructure: the technical (ELM, EDC) and semantic (ESCO) standards that function as the invisible "plumbing" for interoperability. However, it has struggled with the soft infrastructure: the user-facing tools like the Europass CV generator. The standardized format is often criticized by private-sector employers as too rigid and has faced low adoption in many labor markets.

To address this, the European Commission is evolving the platform. In July 2025, it announced a new AI-powered "Smart CV" feature. This tool is designed to analyze a user's full Europass profile and help them generate customized, role-specific CVs that highlight the most relevant skills for a particular job, aiming to bridge the gap between standardized data and the need for personalized presentation.

**Trust Infrastructure: The Case of EBSI and Europeum**

The EU's architecture is designed to support trusted data exchange without centralizing data. One infrastructure piloted for this purpose is the EBSI, a distributed ledger network for public sector services.

Originally a flagship Commission project, EBSI's role has evolved. It is now just one of several potential trust backbones for verifying credentials within the EUDI Wallet framework, and its prominence has lessened. Governance of the network is transitioning to Europeum, an EDIC composed of a smaller group of member states, marking a shift toward a semi-private, consortium-based model. Not all EU countries have joined, indicating that the vision of a single, pan-European blockchain backbone has not fully materialized.

While EBSI demonstrated how verifiable credentials could be anchored on a distributed ledger to ensure authenticity, the EU's framework is infrastructure-agnostic. The system relies on cryptographic verification of credentials, which can be validated against various trusted sources, including national registries or other decentralized networks, not just EBSI. Nonetheless, the innovativeness of EBSI's verification infrastructure may guide future efforts.

Traditional data sharing models, which often rely on centralized databases or real-time API calls, can be vulnerable to outages and raise privacy concerns. In contrast, EBSI is a network of 40 distributed blockchain nodes across Europe. The network is permissioned, meaning only authorized operators can join. EBSI supports "pluggable" protocols and currently runs instances of two prominent blockchain platforms Hyperledger Besu and Fabric, reflecting a pragmatic approach.

EBSI's capabilities fall into two main families: Verifiable Credentials and Track and Trace. Its services include:

- **Verification of Personal Documents:** EBSI allows secure, cross-border sharing of documents like diplomas using decentralized identifiers and verifiable credentials (VCs), enabling instant verification without intermediaries.

- **Verification of Legal Entity Information:** It facilitates reliable verification of companies and institutions.

- **Product Verification:** The infrastructure supports checking a product's authenticity and origin using a decentralized ledger.

EBSI services address the challenge of verifying information, which has historically led to centralized intermediaries and a loss of user control. In the EBSI model, the issuer and verifier are not in direct contact. Instead, citizens manage their information through their digital wallet, and the blockchain enables verification.

The European Commission and member states have run EBSI pilots for several use cases. Cross-border projects with universities and public agencies have focused on education credential verification. One project, for example, involved a Belgian and an Italian university using EBSI to verify Erasmus exchange student records, showing a master's diploma could be verified without traditional notarized copies. Other pilots included municipality certificates for student benefits (Belgium/Spain), European Qualification Passports for refugees to carry verified qualifications (Italy/Germany), and digital student IDs and university alliance credentials to allow students access to services across institutions.

**Key Lessons**

Rather than creating a single, centralized database, the EU is building a distributed, user-centric ecosystem to support worker and learner mobility across its 27 member states.

- **Govern without centralizing control:** The EU demonstrates that an interoperable system can be built through shared standards and collaboration among decentralized jurisdictions, rather than a single federal authority.

- **Prioritize security and privacy-by-design:** The EU's system is built on privacy-by-design principles, with selective data disclosure (EUDI Wallet) and cryptographic verification (EBSI) that avoids a centralized database vulnerable to attacks.

- **Empower individuals with a user-centric approach:** Putting citizens in control of their own data fosters trust and ensures privacy with principles like selective disclosure and data minimization, which allow citizens to decide what information to share.

- **Distinguish hard from soft infrastructure:** The EU's success with technical standards (hard infrastructure) but struggles with user-facing formats (soft infrastructure) offers a crucial lesson. A successful system may require standardizing the invisible technical backbone while allowing for flexibility and market competition in user applications to drive adoption.

- **Verify credentials cryptographically to avoid centralizing data:** The EU's model focuses on instant verification of credentials. This reduces reliance on centralized databases and continuous data transfers that risk privacy.

- **Accelerate adoption through pilots and public-private partnerships:** Using large-scale pilots, innovation challenges, and public-private partnerships can accelerate the development and adoption of new data technologies.

# REFERENCES


Akrigg, M. (2023). *Systemic issues in HMRC Real Time Information (RTI) data collection and customer experience when seeking resolution.* CIPP (Chartered Institute of Payroll Professionals) Report.

Allan, C. & Sanderson, L. (2021). *Labour market impacts of technology change. Evidence from linked employer-employee data*. Chief Economist Unit Working Paper 21/02. New Zealand Ministry of Business, Innovation & Employment.

Almeida, M., Sales Dias, T., Jardim de Farias, R., Soares Martinez, A., Rodrigues Torres, S. & Batista de Oliveira, L. (2020). *Substituição da captação dos dados do caged pelo esocial: implicações para as estatísticas do emprego formal*. IPEA: Mercado de Trabalho, 69.

Australian Taxation Office (2025). *Single Touch Payroll (STP)*. Australian Government.

Australian Taxation Office (2024). *API risk rating*. Australian Government.

Ball, C., Groshenny, N., Karagedikli, M. & Finn, R. (2024). *How Wages Respond to the Job-Finding and Job-to-Job Transition Rates: Evidence From New Zealand Administrative Data*. International Journal of Central Banking, 20 (2), pp. 159-180.

Bender, S., Haas, A. & Klose, C. (2000). *The IAB Employment Subsample 1975-1995*. Journal of Applied Social Science Studies, 120 (4), pp. 649-662.

Bunt, Fearn & Thomas (2013). *PAYE Real Time Information Pilot*. HMRC Research Report 281.

CIPP (2021). *Understanding the relationship between RTI and UC*. Professional in Payrol, Pensions & Reward, Issue 75, p. 25.

Czajka, J., Patnaik, A. & Negoita, M. (2018). *Data on Earnings: A review of Resources for Research*. Mathematica Policy Research.

Department of Employment and Labour, Stats South Africa & International Labour Organization (2024). *Labour Market Information System Master Plan*. Department of Employment and Labour.

Department of Employment and Labour (nd). *Labour Activation Programme. Re-Integrating UIF beneficiaries into the labour market.*

Digital Government (2021). *Integrated data tools*. Statz NZ.

eSocial (2025). *MANUAL DE ORIENTAÇÃO DO eSOCIAL*. Governo Federal.

European Commission (2025). *EU Digital Identity Wallets.*

European Commission (2025). *DC4EU: Digital Credentials for Europe.*

European Commission (2025). *EBSI: European Blockchain Services Infrastructure.*

European Commission (2025). *Verifiable Credentials Framework.*

European Commission (2025). *Understanding EBSI's Blockchain Ecosystem.*

European Commission (2025). *Educational Identification in Europe. EBSI projects.*

European Commission (2025). *Municipality Credentials. EBSI projects.*

European Commission (2025). *Transcript of Records. EBSI projects.*

European Commission (2025). *European Qualification Passport for Refugees. EBSI projects*

European Parliament (2024). *The European Digital Identity Framework.*

Gerard, F. & Gonzaga, G. (2021). *Informal Labor and the Efficiency of Cost of Social Programs: Evidence from Unemployment Insurance in Brazil.* American Economic Journal: Economic Policy, 13 (3), pp. 167-206.

Gil, B. & Aussel, J.D. (2024). *Part I: EU Digital Identity Wallets – Security, Reach & Convenience with Secure Elements.*

Gil, B. & Aussel, J.D. (2024). *Part II: EU Digital Identity Wallets – Security, Reach & Convenience with Secure Elements.*

Goger, A., & McDermott, J. (2021). *Digital Transformation in Labor and Education Systems: Improving the government response to the next unemployment crisis.* Metropolitan Policy Program, Brookings Institution.

Groshen, E., Nightingale, D., Reamer, A., Magdy, Y. & Raju, M. (2022). *Harnessing Employer Records for Enhanced Research, Statistics, and Evaluation. JEDx & U.S.* Chamber of Commerce Foundation.

Guzman-Posadas (2007). *An Exploratory Analysis of Aggregates and Individual Wage Earnings in the Linked Employer-Employee Data (LEED).* Labor, Employment and Work in New Zealand 2006. Statistics NZ.

Heinisch, D., Koenig, J., and Otto, A. (2019). *The IAB-INCHER project of earned doctorates: A supervised machine learning approach to identify doctorate recipients in the German integrated employment biography data.* IAB Discussion Paper.

HM Revenue & Customs (2011). *Improving the operation of Pay As You Earn (PAYE): Collecting Real Time Information'.* Summary of Responses.

HM Revenue & Customs (2012). *RTI Employer Messaging Research. Research to develop and test messages to motivate employers to migrate to RTI effectively.*

HM Revenue & Customs (2014). *Real Time Information (RTI): Improving the operation of Pay As You Earn.*

HM Revenue & Customs (2015). *PAYE Real Time Information (RTI) 'on-or-before' requirement – Research with micro and small employers.* HMRC Research Report 369

HM Revenue & Customs (2017). *Real Time Information Programme. Post Implementation Review report.*

HM Revenue & Customs & U.K. Office for National Statistics (2024). *Response to the OSR review of statistics on earnings and employment from Pay As You Earn Real Time Information.*

Holz, D. (2006). *An Introduction to the Linked Employer-Employee Data (LEED). Labour Market Statistics 2005 – Article 2*. Statistics NZ.

IAB Forum (2023, December 22). *20 years of integrated employment biographies: "For us researchers, the IEB is like a staple food".* [Interview].

International Labour Organization (2023). *International Classification of Status in Employment (ICSE-18) Manual.*

International Labour Organization (2022). *Brazil: Creating fiscal space for social protection through transition to formal employment*. ILO.

JEDx (2024). *Better Data for the Modern Economy.* U.S. Chamber of Commerce Foundation.

JEDx (2024). *Improving Occupational Autocoding.* U.S. Chamber of Commerce Foundation.

JEDx (2023). *The Potential of JEDx to Reduce Employer Burden by Consolidating Reporting to Government: Initial Observations.* U.S. Chamber of Commerce Foundation.

JEDx (2022). *Systems Architecture Technical Workgroup Report. Analysis of Architectural Standards and Pilot Options.* U.S. Chamber of Commerce Foundation.

JEDx (2022). *API DESIGN. Application programming interface to support public-private approaches for enhanced collection and use of standards-based jobs and employment data.* U.S. Chamber of Commerce Foundation.

JEDx (2021). *Modernizing America's workforce data through a public-private approach.* U.S. Chamber of Commerce Foundation.

Jacobebbinghaus, P. & Seth, S. (2007). *The German Integrated Employment Biographies Sample. Schmollers Jahrbuch – Journal of Applied Social Science Studies, 127* (2), pp. 335-342.

Jones, C., Mcdowell, A., Galvin, V. & Adams, D. (2022). *Building on Aotearoa New Zealand's Integrated Data Infrastructure.* Harvard Data Science Review, Issue 4.2.

Kattel, R. & Mergel, I. (2018). *Estonia's digital transformation: Mission mystique and the hiding hand.* Working Paper 2018-09, UCL.

Khuluvhe, M. et al (2022). *Skills Supply and Demand in South Africa.* Labour Market Intelligence research programme. Department of Higher Education and Training.

Koga, N., Palotti, P. & Mello, J. (2024). *Public policy and use of evidence in Brazil: concepts, methods, contexts and practices*. IPEA – Ministry of Planning and Budget.

Levy Yeyati, E. (2025). *Employment records: The missing piece in the US labor market?* Global Development Program, Brookings Institution.

Lichtinger, G. & Hoseeini Maasoum, S.M. (2025). *Generative AI as Seniority-Biased Technological Change: Evidence from U.S.* Résumé and Job Posting Data.

Matha, P. & Jahed, M. (2024). *A Critique of the Techniques Used by the Sectorial Education and Training Authorities to Detect Skills Shortages in South Africa.* Administration Publica, 32 (4), 156-175.

Ministry of Business, Innovation and Employment (MBIE) (2024). *Appendix A: History and methodology. Economic Trends in the New Zealand Screen Sector.*

Ministry of Labor and Social Security (2021). *Nota Técnica – Tratamentos aplicados nos dados do Novo Caged a partir de ajustes na captação dos dados pelo eSocial.*

Ministry of Labour & Employment (2025). *E-Shram: One Stop Solution for Unorganised Workers.* Press Information Bureau.

Ministry of Labour & Employment (2024a). *Registration of gig and platform workers on e-Shram portal of the Ministry of Labour & Employment – regarding (No.W-11015/15/2024-RW).* Government of India.

Ministry of Labour & Employment (2024b). *E-Shram Portal: World's Largest Database of Unorganised Workers.* Press Information Bureau, Government of India.

Ministry of Labour & Employment (2023). *Guidelines on Data Integration/Sharing through eShram Portal with Central Government Ministries.* Government of India.

Ministry of Law & Justice (2020). *The Code on Social Security, 2020.*

Mirelle Alvarez, B. (2023). *Shifting Paradigms: The consequences of Misclassifying Employees as Entrepreneurs*. Sao Paulo School of Economics – Fundação Getulio Vargas.

Mitra, S. (2025). *Social Security Scheme for Welfare of Online Platform Workers, 2025-2026.* IMPRI: Impact and Policy Research Institute.

Morgandi, M, Fietz, K., Ed, M. & Oliveira, G. (2022). *From Struggle to Opportunity. The profile of Brazil's working poor and implications for economic inclusion.* AFD-World Bank Group.

National Informatics Center (2022). *e-SHRAM. Portal for Registration of Unorganized Labourers of India*, Informatics, 30 (3), 2022, 5-8.

Nommik, S. (2024). *Cross-Organisational Collaboration Management of Digital Innovation in the Public Sector – The Case of the Estonian Employment Register.* NISPAcee Journal of Public Administration and Policy, XXVII (1), 142-168.

OECD (2015). *Measuring and Assessing Job Quality. The OECD Job Quality Framework.* OECD Social, Employment and Migration Working Papers N. 174.

Office of Impact Analysis (2019). *Regulation impact statement - Extending single touch payroll to small business employers.* Department of the Prime Minister and Cabinet, Australian Government.

Office of Impact Analysis (2015). *Regulation Impact Statement: Single Touch Payroll.* Department of the Prime Minister and Cabinet, Australian Government.

Pandey, V. (2024). *Evolution of Social Security Worker in India.* University of Lucknow.

Papadopoulos (2008). *Measuring Job Tenure Using Linked Employer-Employee Data*. Labour, Employment and Work in New Zealand. Statistics NZ.

Pena, C. (2018). *Making Wage Data Work: Creating a Federal Resource for Evidence and Transparency.* National Skills Coalition, Workforce Data Quality Campaign (WDQC).

RAIS (2025). *Relação Anual de Informações Sociais – RAIS. Ministerio do Trabalho e Emprego.*

Schmucker, A. & Vom Berge, P. (2025). *Sample of Integrated Labour Market Biographies (SIAB) 1975-2023. FDZ-DATENREPORT.* Research Data Centre of the Federal Employment Agency in the Institute for Employment Research.

Shalini Sinha & Shalaka (2024). *Registering Informal Workers in India: e-Shram, an Opportunity Lost? Women in Informal Employment: Globalizing and Organizing.*

SHRM (2022). *JEDx Value Proposition Research.* SHRM & JEDx.

Stats NZ (2025). *Linked employer-employee data.*

Stats NZ (2025). *Infoshare*.

Stats NZ (2010). *Person-Level Statistics Using Linked Employer-Employee Data*.

Stats South Africa (2024). *South Africa Launches Cutting-Edge Labour Market Information System*.

Swiss South African Cooperation Initiative (2024). *Identification of Skills Gaps in South Africa: A Technical Research Report.* Department of Higher Education and Training -Labour Market Intelligence research programme.

*The Income Tax (Pay As You Earn) (Amendment) Regulations 2012.* U.K. Statutory Instrument 2012/822.

*Tax Administration Act 1994,* Section 81. New Zealand Legislation.

U.K. Department for Work and Pensions (2014). *Real-Time Information Evaluation Report.*

U.K. Office for Statistics Regulation (2023). *Assessment of compliance with the Code of Practice for Statistics. Statistics on earnings and employment from Pay As You Earn Real Time Information (PAYE RTI), U.K.*

U.K. Office for National Statistics (2025). *Quality assurance of administrative data used in earnings and employment from PAYE RTI. Investigation of the administrative data used in production of ONS and HMRC earnings and employment from Pay As You Earn (PAYE) Real Time Information (RTI) data.*

Vella Pateo, F. & Almeida, E. (2025). *O Potencial do eSocial na construçao de evidencias para o aperfeiçoamento de políticas públicas. Dossiê: oportunidades de novas informações para os analistas de mercado de trabalho.* Mercado de trabalho, (79), 207-220.

Wits University (2025). *Plugging South Africa's Skills GAP.* Wits University-Research News.

Work Shift (2023). *National initiative aims to make sense of jobs data-and asks others to join.* US Chamber of Commerce Foundation & JEDx.

World Bank (2021). *Enrollment and eligibility process of Brazil's Auxílio Emergencial. Data Processing and use of administrative registries.* Technical Note No. 1. Brasilia.

Zabala, F., Enright, J. & Seyb, A. (2012). *All the answers? Statistics New Zealand's Integrated Data Infrastructure.* Conference Paper, United Nations, Economic Commission For Europe.

## References: Global Approaches

### United Kingdom

Akrigg, M. (2023). *Systemic issues in HMRC Real Time Information (RTI) data collection and customer experience when seeking resolution.* CIPP (Chartered Institute of Payroll Professionals) Report.

Bunt, Fearn & Thomas (2013). *PAYE Real Time Information Pilot.* HMRC Research Report 281.

CIPP (2021). *Understanding the relationship between RTI and UC*. Professional in Payrol, Pensions & Reward, Issue 75, p. 25

HM Revenue & Customs (2011). *Improving the operation of Pay As You Earn (PAYE): Collecting Real Time Information'. Summary of Responses*

HM Revenue & Customs (2012). RTI Employer Messaging Research. Research to develop and test messages to motivate employers to migrate to RTI effectively

HM Revenue & Customs (2014). *Real Time Information (RTI): Improving the operation of Pay As You Earn*

HM Revenue & Customs (2015). *PAYE Real Time Information (RTI) 'on-or-before' requirement – Research with micro and small employers. HMRC Research Report 369*

HM Revenue & Customs (2017). *Real Time Information Programme. Post Implementation Review report*

HM Revenue & Customs & U.K. Office for National Statistics (2024). *Response to the OSR review of statistics on earnings and employment from Pay As You Earn Real Time Information*

*The Income Tax (Pay As You Earn) (Amendment) Regulations 2012.* U.K. Statutory Instrument 2012/822

U.K. Department for Work and Pensions (2014). *Real-Time Information Evaluation Report*

U.K. Office for Statistics Regulation (2023). *Assessment of compliance with the Code of Practice for Statistics. Statistics on earnings and employment from Pay As You Earn Real Time Information (PAYE RTI), U.K.*

U.K. Office for National Statistics (2025). *Quality assurance of administrative data used in earnings and employment from PAYE RTI. Investigation of the administrative data used in production of ONS and HMRC earnings and employment from Pay As You Earn (PAYE) Real Time Information (RTI) data*

**Germany**

Bender, S., Haas, A. & Klose, C. (2000). *The IAB Employment Subsample 1975-1995.* Journal of Applied Social Science Studies, 120 (4), pp. 649-662.

German's Social Code, Books II (*Basic Security for Jobseekers*), III (*Employment Promotion*) and IV (*General Rules for Social Security*)

Heinisch, D., Koenig, J., and Otto, A. (2019). *The IAB-INCHER project of earned doctorates: A supervised machine learning approach to identify doctorate recipients in the German integrated employment biography data.* IAB Discussion Paper

IAB Forum (2023, December 22). *20 years of integrated employment biographies: "For us researchers, the IEB is like a staple food"*. [Interview].

Jacobebbinghaus, P. & Seth, S. (2007). *The German Integrated Employment Biographies Sample*. Schmollers Jahrbuch – Journal of Applied Social Science Studies, 127 (2), pp. 335-342.

Schmucker, A. & Vom Berge, P. (2025). *Sample of Integrated Labour Market Biographies (SIAB) 1975-2023.* FDZ-DATENREPORT. Research Data Centre of the Federal Employment Agency in the Institute for Employment Research

**Australia**

Australian Taxation Office (2025). *Single Touch Payroll (STP)*. Australian Government.

Australian Taxation Office (2024). *API risk rating*. Australian Government.

Australian Taxation Office (2025). *Operational Framework. Software Developers*. Australian Government

Office of Impact Analysis (2019). *Regulation impact statement - Extending single touch payroll to small business employers.* Department of the Prime Minister and Cabinet, Australian Government.

Office of Impact Analysis (2015). *Regulation Impact Statement: Single Touch Payroll.* Department of the Prime Minister and Cabinet, Australian Government.

**New Zealand**

Allan, C. & Sanderson, L. (2021). *Labour market impacts of technology change. Evidence from linked employer-employee data.* Chief Economist Unit Working Paper 21/02. New Zealand Ministry of Business, Innovation & Employment.

Ball, C., Groshenny, N., Karagedikli, M. & Finn, R. (2024). *How Wages Respond to the Job-Finding and Job-to-Job Transition Rates: Evidence From New Zealand Administrative Data.* International Journal of Central Banking, 20 (2), pp. 159-180.

Digital Government (2021). *Integrated data tools.* Statz NZ.

Holz, D. (2006). *An Introduction to the Linked Employer-Employee Data (LEED). Labour Market Statistics 2005 – Article 2.* Statistics NZ

Jones, C., Mcdowell, A., Galvin, V. & Adams, D. (2022). *Building on Aotearoa New Zealand's Integrated Data Infrastructure.* Harvard Data Science Review, Issue 4.2

Ministry of Business, Innovation and Employment (MBIE) (2024). *Appendix A: History and methodology.* Economic Trends in the New Zealand Screen Sector.

Papadopoulos (2008). *Measuring Job Tenure Using Linked Employer-Employee Data.* Labour, Employment and Work in New Zealand. Statistics NZ.

*Tax Administration Act 1994, Section 81*. New Zealand Legislation.

Stats NZ (2025). *Linked employer-employee data.*

Stats NZ (2025). *Infoshare.*

Stats NZ (2010). *Person-Level Statistics Using Linked Employer-Employee Data.*

Zabala, F., Enright, J. & Seyb, A. (2012). *All the answers? Statistics New Zealand's Integrated Data Infrastructure.* Conference Paper, United Nations, Economic Commission For Europe.

**Brazil**


Almeida, M., Sales Dias, T., Jardim de Farias, R., Soares Martinez, A., Rodrigues Torres, S. & Batista de Oliveira, L. (2020). *Substituição da captação dos dados do caged pelo esocial: implicações para as estatísticas do emprego formal.* IPEA: Mercado de Trabalho, 69.

eSocial (2025). *MANUAL DE ORIENTAÇÃO DO eSOCIAL.* Governo Federal.

Koga, N., Palotti, P. & Mello, J. (2024). *Public policy and use of evidence in Brazil: concepts, methods, contexts and practices.* IPEA – Ministry of Planning and Budget.

Ministry of Labor and Social Security (2021). *Nota Técnica – Tratamentos aplicados nos dados do Novo Caged a partir de ajustes na captação dos dados pelo eSocial.*

Mirelle Alvarez, B. (2023). Shifting Paradigms: *The consequences of Misclassifying Employees as Entrepreneurs.* São Paulo School of Economics – Fundação Getulio Vargas.

Morgandi, M, Fietz, K., Ed, M. & Olvieira, G. (2022). *From Struggle to Opportunity. The profile of Brazil's working poor and implications for economic inclusion*. AFD-World Bank Group.

RAIS (2025). *Relação Anual de Informações Sociais – RAIS.* Ministerio do Trabalho e Emprego.

Vella Pateo, F. & Almeida, E. (2025). *O Potencial do eSocial na construçao de evidencias para o aperfeiçoamento de políticas públicas.* Dossiê: oportunidades de novas informações para os analistas de mercado de trabalho. Mercado de trabalho, (79), 207-220.

World Bank (2021). *Enrollment and eligibility process of Brazil's Auxílio Emergencial. Data Processing and use of administrative registries.* Technical Note No. 1. Brasilia.


**Estonia**


Estonian Business and Innovation Agency. *e-Estonia*.

Estonian Business and Innovation Agency. *X-Road*.

Estonian Tax and Customs Board (2025). *Employment Register*.

European Commission (2019). *Estonian Register of Employment*.

Kattel, R. & Mergel, I. (2018). *Estonia's digital transformation: Mission mystique and the hiding hand*, Working Paper 2018-09, UCL

Nommik, S. (2024). *Cross-Organisational Collaboration Management of Digital Innovation in the Public Sector – The Case of the Estonian Employment Register*. NISPAcee Journal of Public Administration and Policy, XXVII (1), 142-168

World Bank (2022). *GovTech Maturity Index (GTMI)*.

**India**


Ministry of Labour & Employment (2025). *E-Shram: One Stop Solution for Unorganised Workers. Press Information Bureau.*

Ministry of Labour & Employment (2024a). *Registration of gig and platform workers on e-Shram portal of the Ministry of Labour & Employment – regarding* (No.W-11015/15/2024-RW). Government of India.

Ministry of Labour & Employment (2024b). *E-Shram Portal: World's Largest Database of Unorganised Workers.* Press Information Bureau, Government of India.

Ministry of Labour & Employment (2023). *Guidelines on Data Integration/Sharing through eShram Portal with Central Government Ministries.* Government of India.

Ministry of Law & Justice (2020). *The Code on Social Security, 2020*.

Mitra, S. (2025). *Social Security Scheme for Welfare of Online Platform Workers, 2025-2026.* IMPRI: Impact and Policy Research Institute

Pandey, V. (2024). *Evolution of Social Security Worker in India.* University of Lucknow.

Shalini Sinha & Shalaka (2024). *Registering Informal Workers in India: e-Shram, an Opportunity Lost?* Women in Informal Employment: Globalizing and Organizing.


**South Africa**


Allais, S. and Ngcwangu, S. (2024). *Part 1: Getting SA's skills needs right. Wits University Opinion.* 17 July 2024.

Department of Employment and Labour, Stats South Africa & International Labour Organization (2024). *Labour Market Information System Master Plan.* Department of Employment and Labour.

Department of Employment and Labour (nd). *Labour Activation Programme. Re-Integrating UIF beneficiaries into the labour market.*

Department of Higher Education and Training (2012). *The Sector Education and Training Authorities (SETAs) Grant Regulations regarding monies received by a SETA and related matters*. Government Notice No. R.990, Government Gazette No. 35940. Republic of South Africa.

Khuluvhe, M. et al (2022). *Skills Supply and Demand in South Africa*. Labour Market Intelligence research programme. Department of Higher Education and Training.

Matha, P. & Jahed, M. (2024). *A Critique of the Techniques Used by the Sectorial Education and Training Authorities to Detect Skills Shortages in South Africa.* Administration Publica, 32 (4), 156-175.

Stats South Africa (2024). *South Africa Launches Cutting-Edge Labour Market Information System.*

Swiss South African Cooperation Initiative (2024). *Identification of Skills Gaps in South Africa: A Technical Research Report*. Department of Higher Education and Training -Labour Market Intelligence research programme.

Wits University (2025). *Plugging South Africa's Skills GAP.* Wits University-Research News.

**European Union**

European Commission (2025). *EU Digital Identity Wallets.*

European Commission (2025). *DC4EU: Digital Credentials for Europe.*

European Commission (2025). *EBSI: European Blockchain Services Infrastructure.*

European Commission (2025). *Verifiable Credentials Framework.*

European Commission (2025). *Understanding EBSI's Blockchain Ecosystem.*

European Commission (2025). *Educational Identification in Europe.* EBSI projects

European Commission (2025). *Municipality Credentials.* EBSI projects

European Commission (2025). *Transcript of Records.* EBSI projects

European Commission (2025). *European Qualification Passport for Refugees.* EBSI projects

European Parliament (2024). *The European Digital Identity Framework*.

Gil, B. & Aussel, J.D. (2024). *Part I: EU Digital Identity Wallets – Security, Reach & Convenience with Secure Elements.*

Gil, B. & Aussel, J.D. (2024). *Part II: EU Digital Identity Wallets – Security, Reach & Convenience with Secure Elements.*

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