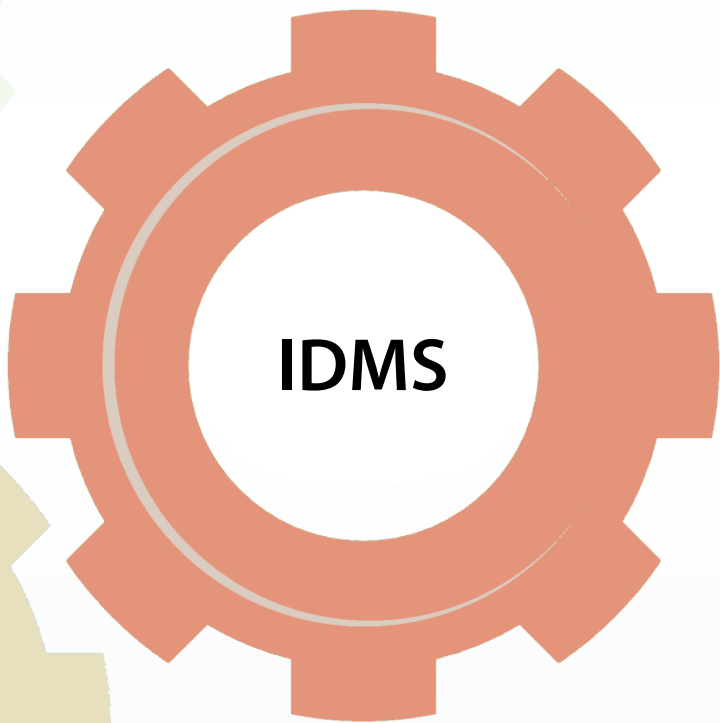


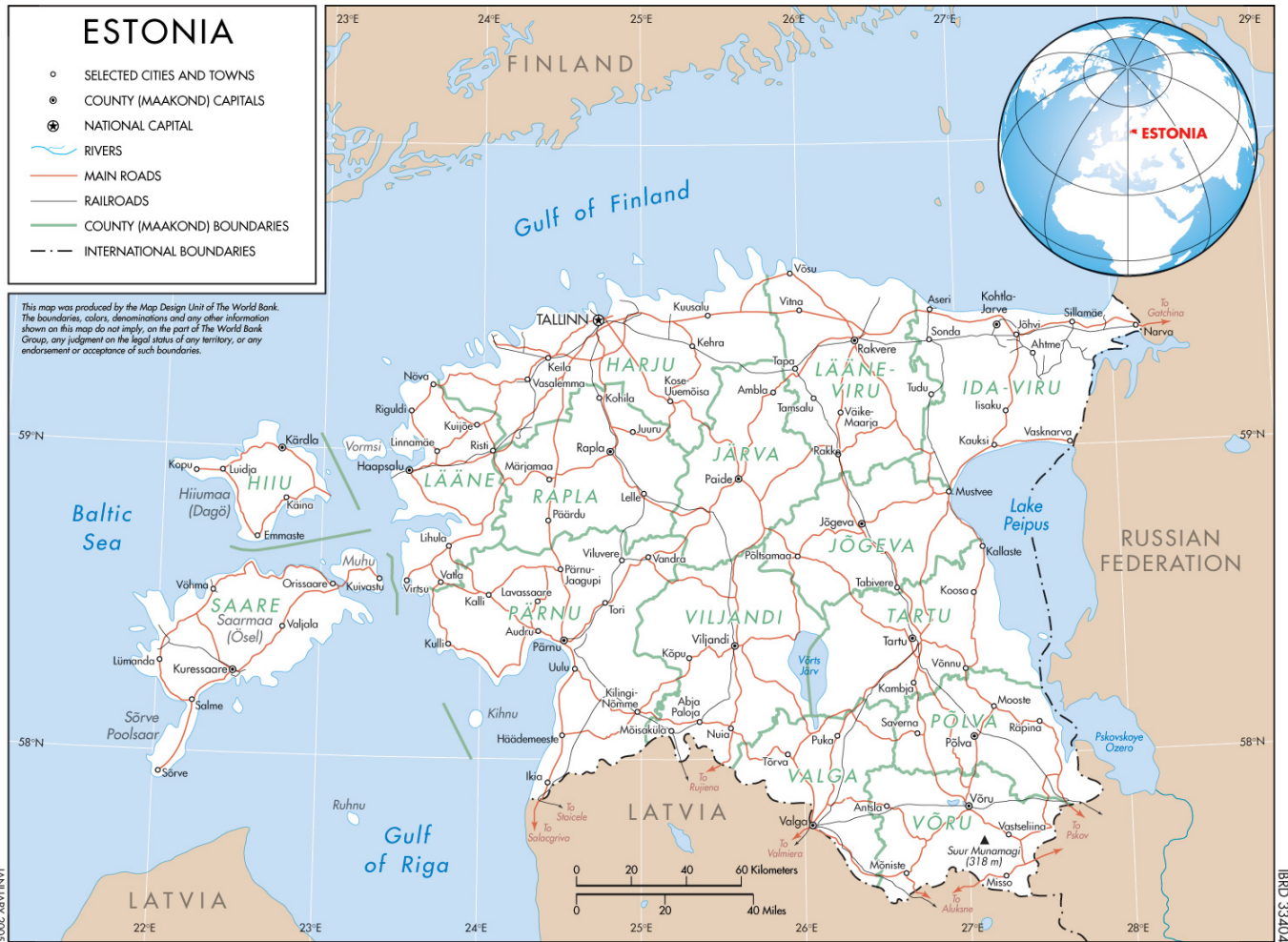
ESTONIA

A SUCCESSFULLY INTEGRATED POPULATION-REGISTRATION AND IDENTITY MANAGEMENT SYSTEM

DELIVERING PUBLIC SERVICES EFFECTIVELY



Map of Estonia



ESTONIA:

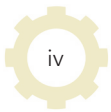
**A SUCCESSFULLY INTEGRATED
POPULATION-REGISTRATION AND
IDENTITY MANAGEMENT SYSTEM
DELIVERING PUBLIC
SERVICES EFFECTIVELY**

November, 2015



CONTENTS

Acknowledgments	v
Acronyms	vii
Introduction	ix
<i>Why Estonia?</i>	ix
<i>Why focus on the health sector?</i>	x
<i>Organization of the report</i>	xi
1 Background	1
<i>Democracy and openness</i>	2
<i>Demographic challenges: Aging and population decline</i>	2
<i>Wide-spread innovative Information and Communication Technology (ICT)</i>	3
2 Principles of Integration	5
<i>Main goal: Providing legal identity</i>	5
<i>Rationale: Why integration is a good practice?</i>	6
<i>Fundamental building blocks</i>	6
3 Overview of PR and ID systems integration	9
<i>Evolution of integration</i>	9
1. <i>Demand for identification (1991–1992)</i>	10
2. <i>Design and early implementation (1992–2000)</i>	10
3. <i>Roll-out and completion (2000–2005)</i>	11
<i>Governance architecture</i>	12
4 Population registration and register-based statistics in Estonia	15
<i>Guiding principles of the Estonian population registration system</i>	16
<i>Population register: Structure and operation</i>	16
<i>Birth registration</i>	18
<i>Death and cause of registration process</i>	20
<i>Best practices: population-based registration system</i>	22



5	Estonia Identification Management System	23
	<i>The structure and operation</i>	23
	<i>A constitutional right: Personal data protection</i>	24
	<i>Personal ID code (PIC)</i>	24
	<i>Electronic Identification card (eID)</i>	25
	<i>e-Residency</i>	27
	<i>Best practices: eIDM system</i>	28
6	X-Road: The bridge between PR, ID card and service delivery	29
7	Key enablers and critical success factors for integration	35
	<i>Governance and legal framework</i>	35
	<i>Information technology and Public Key Infrastructure (PKI)</i>	36
	<i>The role of Public-Private Partnerships (PPPs)</i>	37
8	Applied case: Improving health care delivery through an integrated identification system	39
	<i>Overview of the Estonian health system</i>	39
	<i>eHealth: An integrated health information system</i>	40
	<i>Interconnection of the health insurance registry and the population register</i>	42
	<i>Health insurance since birth</i>	42
9	Lessons learned	43
10	References	45



ACKNOWLEDGMENTS

This report was prepared by Ana Milena Aguilar Rivera, Health Economist, Health, Nutrition and Population Global Practice (HNP), World Bank Group (WBG), and co-authored by Dr. Kristjan Vassil, University of Tartu. Dr. Vassil provided excellent analytical inputs, review of legal documentation, and the construction of figures about X-Road transactions and data requests. Technical guidance was provided by Dr. Samuel Mills, Senior Health Specialist, HNP. This case study is part of a series of case studies undertaken by the World Bank Civil Registration and Vital Statistics (CRVS) program, which is part of the WBG Identification for Development Group (ID4D).

A number of Estonian government officials and stakeholders provided valuable insights and information during our field visit to Tallinn in May 2015. Officials in the Police and Border Guard Board (including Mr. Janek Mägi the Head of the Citizenship and Migration Policy Department, and Mr. Helar Laasik, Chief Expert), and the Head of the Population Department and colleagues responsible for the Population Register (Mrs. Enel Pungas, Ms. Terje Maurer, and Ms. Mairis Kungla)—both offices being under the Ministry of Interior—are gratefully acknowledged. In addition, officials from the Estonian Information System's (RIA) described for us the information system and the role of X-Road. We thank especially Ms. Liina Areng and Mr. Andres Kütt for their invaluable help. We appreciate the time and knowledge provided by Mr. Mait Heidelberg at the Ministry of Economic Affairs and Communication, Mrs. Mari Pedak at the eGovernment Academy, and Mr. Tarvi Martens at the Certification Center (SK). The heads of the Medical Birth Registry (Mrs. Kärt Allvee), the Cause of Death Registry (Mr. Gleb Denisov), and the Cancer Registry (Mrs. Margit Mägi) under the National Institute for Health Development (NIHD) clearly explained the integration of the health registries and the Population Register. The head of Health Statistics (Ms. Natalja Eigo) provided inputs and information on the health information system, which was greatly appreciated, and Mrs. Kaja Sõstra and Mrs. Kristi Lehto representatives of Statistics Estonia provided useful information on Estonia's statistics system. This report also benefited from the time and critical insights of officials from the health sector, in particular, Ms. Triin Habicht of the Ministry of Social Affairs, Mr. Raul Mill and Mrs. Heli Laarmann from the ehealth Foundation, and officials from the Estonian



Health Insurance Fund (EHIF). Our thanks to Ms. Kaija Lukka for her support and help.

Additionally, World Bank Group staff who work on issues relating to Estonia, particularly Marvin

Ploetz, Märt Kivine, and Christophe Kurowski, provided insightful information and suggestions, and we appreciate the help provided by Victoriano Arias.



ACRONYMS

BMR	Birth Medical Registry
CODR	Cost of Death Registry
CRVS	Civil Registration and Vital Statistics
DSA	Digital Signature Act
EDPI	Estonian Data Protection Inspectorate
EHIC	European Health Insurance Card
EHIF	Estonian Health Insurance Fund
EHR	Electronic health record
EHSI	Estonia Health System Information
eIDMS	Electronic Identification Management System
eID	Electronic Identification
EMBR	Estonian Medical Birth Registry
eSignature	Digital Signature
GOE	Government of Estonia
ICT	Information and Communication Technology
ID	Identification
IDMS	Identification Management System
MISP	Mini-Information System Portal
MoI	Ministry of Interior
MoSA	Ministry of Social Affairs
NIHD	National Institute for Health Development
PBGB	Police and Border Guard Board
PDPA	Personal Data Protection Act
PIA	Public Information Act
PIC	Personal Identification Code
PKI	Public Key Infrastructure
PPP	Public and Private Partnerships
PR	Population Register



PRA	Population Register Act
RIA	Estonian Information System Authority
RIK	Centre of Registers and Information Systems
SE	Statistics Estonia
SK	Certification center
VSA	Vitals Statistic Act
WHO	World Health Organization



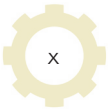
INTRODUCTION

Integrated civil registration and vital statistics (CRVS) and identity management systems (IDMS) provide a critical basis for identity management and the establishment of personal identity. When developed in an integrated matter, these systems can provide major savings in terms of time and costs, in addition to creating efficiencies in the flow of information across relevant institutions. Some countries are leading the development of more integrated approaches, and the lessons learned, if properly documented, may be useful to many low- and middle-income countries.

This report describes the particular case of Estonia, and the process through which the country has developed an integrated population registration and identification system aiming at improve public service delivery. The report identifies enabling factors and best practices that may be applicable to other countries. The audience of this report includes both policymakers and stakeholders interested in developing national population-based identification systems in conjunction with improving government services delivery, in particular health care services.

Why Estonia?

Estonia, one of the three Baltic countries, experienced a political and economic reorganization after regaining its independence from the Soviet Union in 1991. One of the first priorities of the newly established government was to rebuild a national identity system. As a result, during the 1990s, the legal foundations for the new system were laid out, and both a national identification number system and a population register were established. Since then, Estonia has rolled out a compulsory national identification card program and introduced secure, authenticated digital identities, which are widely used and trusted, for citizens to use when accessing public services. With more than 1.2 million active electronic identification (eID) cards issued to nearly 95 percent of its 1.3 million residents, Estonia has not only successfully developed an effective new system, but has also become an exemplary case for countries designing new population registration systems or reestablishing population registries after periods of political instability and unrest.



In Estonia, the activities involved in identification, population registration, and vital statistics are carried out within two key subsystems. The first is the population registration system (or CRVS)¹, which is aimed at recording and certifying births, deaths, and other vital events occurring in the population. The second is the identification management system (IDMs), the purpose of which is to provide legal identification and associated documents to the population. These subsystems complement each other rather than duplicating their functions. These complementarities provided the basis for their integration. The establishment of a legal basis for collaboration, information technology solutions to ensure interconnection, and harmonization of guiding principles and goals of participating agencies, ensured a successfully integrated identification system.

Currently, Estonia is considered a pioneer in implementing an innovative and integrated identification system characterized by its interoperability with other cross-government systems, having developed one of the most renowned eGovernment² strategies in the world. Today, there is an interoperable platform supporting the eGovernment in Estonia—X-Road—a technical and organizational environment that enables secure Internet-based data exchange between the state's information systems. It connects 900 organizations and more than 1,000 services, handling more than 300 million requests per year (in 2014). Estonia also serves as a good example of the roles that information technology, public procurement, and public-private sector partnerships play in consolidating a national identification and population-registration system.

Why focus on the health sector?

A nation's health sector is both the primary source and primary user of birth and death registration data. By facilitating birth registration, health service providers play an important role in creating the initial identification record for a newborn, as well as in recording deaths and the causes of death later in life. Because

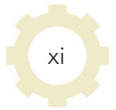
child and maternal mortality estimates require robust and accurate birth and death information, CRVS also plays an essential role in monitoring Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) in developing countries, especially for the poor.

Poor women and children represent the group with the greatest vulnerabilities associated with not having registration. For example, poor children are disproportionately more likely to die without having birth registration. In countries with developed ID systems, such as Estonia, identification starts at birth, and is linked to a child's mother. The development of technologies has created opportunities for cost-saving solutions such as birth hospital electronic registration. Thus, efforts to integrate CRVS and ID systems through the use of technology carry the potential for reducing both disparities among individuals and long-term costs for organizations.

Furthermore, by improving the health sector information system, an integrated system produces system externalities such as increasing efficiency and accuracy. Estonia's health care system has capitalized on the e-services platform part of the Electronic Identification Management System (eIDMS). Both the electronic health registry that was initiated in 2008 and the e-prescription system that was implemented in 2010 have increased efficiency by limiting the administrative burden on doctors, enabling access to time-critical information, and automating data collection. The Electronic Health Record (EHR) is built around the X-Road system, which allows access to data from other

¹ In this report, the term “population registration” is used in place of “civil registration” to adhere to international terminology to designate when a system is based on a population register (PR) rather than a civil registry. One key difference between these two types of systems is that PR systems are organized and collect data on the basis of place of residence.

² “eGovernment uses digital tools and systems to provide better public services to citizens and businesses” (European Commission).



systems, including the Population Register. Hence, the lessons that have resulted from Estonia's health experience are of importance not only for countries in the early stages of CRVS system development, but also for middle-income countries looking to improve efficiency by applying innovative solutions and e-health approaches.

Organization of the report

This report is organized in nine sections. The first section provides background information on Estonia. The second section introduces an analytical framework and

presents the key elements that are necessary for the successful integration of identification and population registration systems. The third section describes the evolution of the PR and ID system in Estonia, followed by a description of the population registration system, the enabling factors, and the benefits. Similarly, the fifth section analyzes the identification management system and related best practices. The sixth section describes the data exchange platform X-Road. The seventh section summarizes the key enablers and success factors for integration. Whereas section eight outlines the benefits of system integration in the health sector. Finally, a conclusion chapter highlighted the lessons learned in the report.



1 BACKGROUND

Estonia is situated strategically on the east coast of the Baltic Sea bordered by Finland to the north and the Russian Federation to the east. It is the smallest and most northerly state of the Baltic countries—Estonia, Latvia, and Lithuania (table 1.1). With a current population of 1,313,271 inhabitants, Estonia is the fourth smallest country in the European Union. Its territory, approximately 45,227 km², is larger than that of Belgium or Switzerland, but at 31 inhabitants per square kilometer, it is one of the least-densely populated countries in Europe. Currently, the country is organized into 15 counties, the first-level administrative subdivision, and further into 213 municipal districts, including 30 towns and 183 parishes. One-third of the population is concentrated in its capital, Tallinn, which is the main destination of internal migration (Statistics Estonia 2013).

The development of the current identification and population registration systems in Estonia occurred in tandem with other significant changes in the country's policy and economic environment, which were initiated after Estonia regained independence from the Soviet Union in 1991. Other factors, such as social and demographic dynamics, and striking technological change, also influence how the country's unified CRVS/ID system works.

Table 1.1 ■ Statistics

Population:	1 313 271 (2015)
Density	30.3 inhabitants per km ²
Share of urban residents	67.9%
Area	45 227 km ²
GNI per capita	18,530
Life expectancy	76
Unemployment rate	8.8%
Birth registration	100%
Death registration	90% or more

Source: WDI, 2015 and UNSC, 2013



Democracy and openness

Since 1991, Estonia has been governed by a parliamentary democracy in which the Prime Minister is the head of the government and the President is the Head of State. Free and fair elections have been held since that time with robust levels of turnout and party system stability (Lewis, 2006). Estonia's central government is deconcentrated with a single-tier subnational government at the county level (OECD, 2011). The government is comprised of 11 ministries, each with respective subordinate agencies (boards and inspectorates). The Ministry of Interior, through the Police and Border Guard Board and the Population Fact department, coordinates the national identification and the population registration systems.

After regaining independence in 1991, Estonia faced the challenge of transitioning from a centrally planned socialist system to a new open-market environment based on democratic institutions. The government needed to establish a new currency, stabilize prices, and reactivate the economy (Boughton 2012). By applying sensible fiscal and macroeconomic policies, promoting democratic institutions, and integrating rapidly to a global governance scenario, in less than a decade, the government was able to balance the government budget while restoring growth in real GDP. Between 2000 and 2008, the country experienced rapid economic growth of about 7 percent per year, which placed Estonia among the top three fastest growing economies in the EU.³ The economic crisis of 2008 impacted the Estonian economy by decreasing GDP growth by 14.7 percent, but since 2010, economic growth has turned positive again—in 2014 the Estonian economy grew 2.1 percent compared to 2013.⁴

The Estonian economy is characterized by flexibility and openness. Since 1991, all Estonian governments have valued a balanced state budget, liberal trade and investment laws, and low levels of corporate income tax. Currently, The Wall Street Journal and the Heritage Foundation's Index of Economic Freedom 2015 ranks Estonia as one of the freest economies in the world at

eight out of 178 countries.⁵ Estonia is also known for its low flat-rate taxes and in particular its 20 percent income tax. In order to attract more foreign direct investment, all reinvested corporate profits are exempt from corporate income tax. The system of value-added tax (VAT), set at 20 percent, is in harmony with EU requirements. Employers pay a social and health insurance tax, which is 33 percent of gross wages.

Despite sound economic growth, 18 percent of the Estonian population lives in relative poverty, and 8 percent in extreme poverty, based on the national poverty line (Statistics Estonia, 2015). According to Statistics Estonia, the unemployment rate was 6.6 percent in the first quarter of 2015.⁶ In 2014, the average monthly gross wages and salaries were 1,005 euros and the average hourly gross wages and salaries were 6.14 euros.⁷

Demographic challenges: Aging and population decline

The Estonian population can be characterized by two major trends. First, the population, similar to other European countries, is aging. Children under 14 years old constituted about 18 percent of the population in 2000 but their share decreased to 15 percent in 2011. Conversely, the share of those over 65 years has increased to 18 percent as compared to 15 percent in 2000. On a positive note, the share of working-age people (15–65 years) was about 67 percent in 2000 as well as in 2011.⁸

³ <http://estonia.eu/about-estonia/economy-a-it/a-dynamic-economy.html>.

⁴ <https://www.eestipank.ee/en/press/eesti-pank-raised-its-forecast-economic-growth-year-and-lowered-its-forecast-next-year-23092014>.

⁵ <http://www.heritage.org/index/ranking>.

⁶ <http://www.stat.ee/90621>.

⁷ <http://www.stat.ee/90547>.

⁸ <http://www.stat.ee/63779>.

In the past 20 years, the population of Estonia has gradually decreased due to a negative birth rate and net migration (figure 1.1). Estonia's population, according to the 2011 population census, was 1.29 million, which indicates a 5.8 percent decline from its 2000 population level. As occurs in other East European countries, Estonia's population decline brings about a number of challenges to the government, including an aging workforce leading to possible labor and skill shortages and a smaller tax base leading to reduced tax revenue.

The decline in natural growth is primarily a consequence of a prevailing low fertility rate in the country. Estonia's fertility rate has remained at levels below replacement (2.0) since the 1990s (figure 1.2). Birth rates began falling after the restoration of independence in 1991, and in 1998 declined even further to a level of 1.28 children per woman, the lowest level in 40 years. However, the fertility rate recovered after that period to an estimated current rate of 1.54 children per woman.

The second major population trend shows a continuing regional concentration. Overall, the number of registered inhabitants has increased in two counties Harju and Tartu, in which the two largest cities of Estonia are found (Tallinn in Harju County and Tartu in Tartu County), while the number of people in other counties has decreased, and these two counties are the only counties with a positive net inflow of people.⁹

Wide-spread innovative Information and Communication Technology (ICT)

As a small country, Estonia, has prioritized investing in innovative and efficient solutions to a shrinking work force. Among them are new information technologies, widespread Internet-based public services, and mobile value-added services (m-services) (Kalvet, 2012). As a technology-oriented economy and society, Estonia made technology adoption and development one of its more valuable comparative advantages.

According to the World Bank, Estonia's current Internet penetration is 84 percent, above the European

Figure 1.1 ■ Change in Population between 2000 and 2014 (Statistics Estonia, 2015)

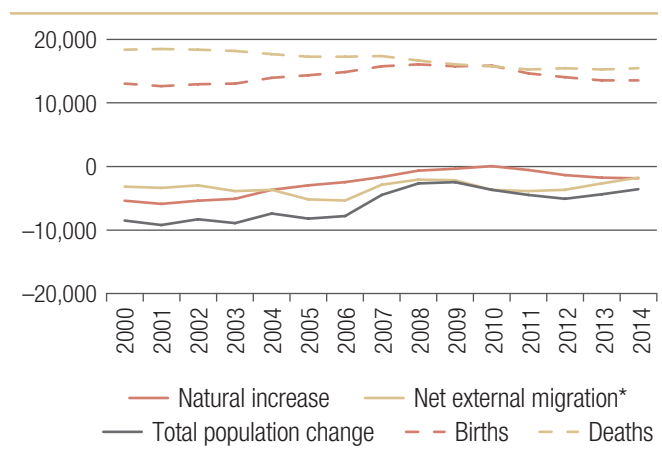
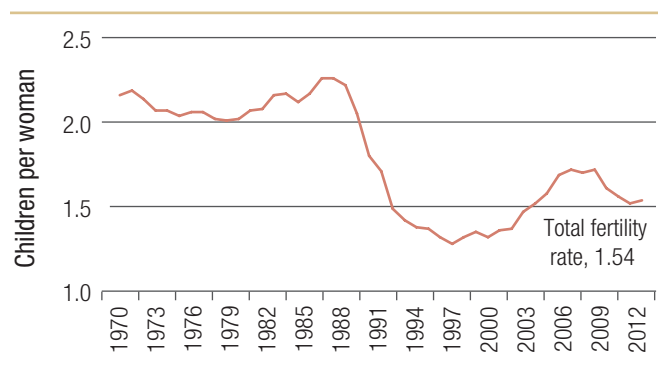


Figure 1.2 ■ Total Fertility Rate, Estonia 1970–2014



Union average of 78 percent (WDI, 2014). Yet, Internet users in the early 2000s were less than one third of the population. A 2002 study about the digital divide¹⁰ characterized Estonia as a country with relatively few

⁹ Data and further information available at: <http://www.stat.ee/63779>.

¹⁰ "Digital divide: the gap between individuals, households, businesses, and geographic areas at different socioeconomic levels with regard both to their opportunities to access information and communication technologies and to their use of the Internet. The digital divide reflects various differences among and within countries (OECD 2001, 5)."



Internet users, limited access to computers, and a growing but still insufficient number of public Internet access points (Kalvet, 2002). There were, however, two key public-private partnerships projects that started the widespread use of the Internet. First, in 1997, the Tiger Leap program was initiated to modernize the country's IT-infrastructure¹¹ providing Internet access and computer labs to all Estonian schools. Second, the largest public-private partnership project in Estonia to date—the Look@World project with nine participating companies—was started in 2001. As a result, more than 100,000 individuals, about 10 percent of the Estonian adult population, were taught to use and understand

ICTs. The project raised the number of public Internet access points from 200 in 2001 to about 700 in 2004. Thus, although the choice to steer the country toward new technologies was a political one, early on it was funded by the private sector.

¹¹ Tiger's Leap was a government project that started in 1997 with the goal to substantially increase investments in the development and expansion of personal computers and network infrastructure in Estonia, with a particular emphasis on education. The primary outcome of the project was the provision of Internet access and computer labs to all Estonian schools.



2 PRINCIPLES OF INTEGRATION

A successfully integrated identification system, such as the one developed in the Estonian case, takes into account the complementarities among different identification systems by laying out the legal basis for collaboration, designing information technology solutions to ensure interconnection, and establishing consistent guiding principles and goals for collaborating agencies.

Main goal: Providing legal identity

The main benefit of having an integrated identification system is providing people with legal identity. Possessing a legal identity allows individuals to have access to public services and to protect their rights. There is also evidence that lacking a legal identity has negative consequences for vulnerable populations in risky situations. In particular, the poor are more vulnerable to becoming legally “invisible.” Having a unified, coordinated identification system creates long-lasting benefits for individuals by providing protection for children from birth. When birth registration is not part of a central national system, and there is no connection between birth registration and other public services, there is no way to certify that the person holding a birth certificate is the person for whom it was issued. On the other hand, identification systems focused exclusively on personal identification, which use ID cards, usually target adults rather than children, limiting children’s access to public services. The concept of legal identity is not without challenges, as some people might say that providing legal identity may also create vulnerability and exposure if sensitive information is not protected, or if access is not controlled by data protection and confidentiality regulations.

Rationale: Why integration is a good practice?

One of the main problems occurring in identification systems today is the issue of fragmentation. This occurs when separate identification structures and databases are created in order to satisfy sector-specific demands without establishing standards and systems for their integration and coordination. For instance, population censuses, social health insurance records, voters' lists, and tax identification databases collect the same basic information, but there are no standards to adequately integrate them or to ensure confidentiality and information security. These basic standards of data acquisition are usually difficult to put into practice given the number of agencies responsible for these registries and the manner in which these databases are developed.

Among the issues that an integrated system should seek to address are the following:

- Multiple data collection and repeated information in databases
- Inefficiencies in data integration and reporting
- Occurrences of invisible populations or missing births or deaths due to inaccurate or missing information
- Irregularly updated information concerning the entry and exit of people in registries of government programs (welfare, education, pensions)

More importantly, an integrative system aims to ensure appropriate use of sensitive information, and the protection and security of the data of individuals whose records are contained in it.

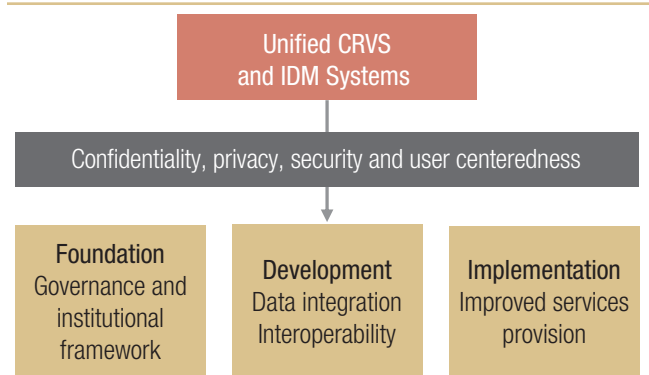
Fundamental building blocks

What are the fundamental building blocks in Estonia that drive the process of integration and make up the infrastructure required to properly enable it? This section presents a framework linking key domains of

integration—including foundation, development, and implementation—as a tool to understand the process of creating an integrated system. It has been proposed that the integration of identification and population registration systems should follow two key principles: ensuring the confidentiality, privacy, and security of personal information; and supporting the efficient provision of public services (user-centeredness). Protecting personal data is a matter of critical importance to guarantee individual rights and to ensure that the information is both gathered legally and used for legitimate purposes, whereas user-centeredness refers to the practice of placing individuals or citizens (users) at the center of the system. The obligation and aim of such a system is to allow individuals to maintain control over their personal data and its use.

Figure 2.1 shows the foundation components for successful system integration. The first basic element is establishing a comprehensive legal framework to guide the process of integration. An integrated identification system relies on a clear division of responsibilities and cooperation among administrative authorities. A unified system also requires enabling provisions that establish the way the different agencies interact. Among these key provisions are the issuance of a personal identification code, the guarantee of personal data protection to ensure transparency in the exchange of public information, and the creation and operation of digital solution and technological information platforms.

Figure 2.1 ■ Building Blocks



Source: Authors.



The development of a unified system primarily involves issues of coordination across agencies and of interoperability. One of the key challenges rests with how to integrate datasets and registries while at the same time ensuring data protection and confidentiality. Data Integration refers to implementing the set of processes required for harmonizing data from separate sources and for creating ways of monitoring, transforming, and delivering this information. In the case of ID and CRVS systems, these different sources encompass

birth and death registries, as well as individual identification registries, such as lists of taxpayers and election voters, policy records systems, and health insurance registries. Integration requires establishing a platform that enables different information systems to communicate and exchange data with each other.

Finally, any integrated system requires constant updating, monitoring, and cleaning of data to provide information for effective government, but more importantly to provide improved service delivery.



3 OVERVIEW OF PR AND ID SYSTEMS INTEGRATION

In Estonia, identification, population registration, and vital statistics activities are carried out within two key subsystems. The first is the population registration and vital statistics system (CRVS), which is aimed at recording and certifying births, deaths, and other vital events occurring in a population. The second is the identification management system (IDMS), which is focused on providing legal identity and associated documents to the population. These subsystems complement each other rather than duplicating their functions. These complementarities provided the basis for their integration.

Evolution of integration

The historical evolution of identification and population registration systems in Estonia is crucial to understanding Estonia's successful integration of these processes. Three particularly effective practices in this model are: (i) early introduction of a personal identification number (even before the ID card and a population register were established); (ii) cooperation among ministries and scientific institutions involved in data collection, analysis, publication, and storage; and (iii) use of a population register to support the national identity program.

During the early 1990s, as a result of the dissolution of the former Soviet centralized system, Estonia, like other ex-Soviet republics, faced the challenge of developing new and improved systems of population registration and vital statistics data collection. The previous system suffered from over-centralization, poor quality control, and data comparability issues. In addition, population statistics were not freely distributed, and the use of such information was restricted (Anderson, Katus et al. 1994). As a result, in 1992 the Estonian Government formed a governmental commission to establish a population register that would

be at the center of the population registration effort. The state agencies involved in the process were the then Passport Bureau, the Residence Address Bureau, and the Estonian Statistics Bureau, which was in charge of data storage (Kulper, 2014). The commission also had the support of scientific institutions involved in population data collection and analysis. (Anderson, Katus et al. 1994). Their goal was to provide the basic structure for establishing the principles and practices for a population register.

1. Demand for identification (1991–1992)

Notwithstanding this government interest in developing a population-based registration and identification system, the initiative has since its inception responded to a demand for identification by Estonian citizens who called for a new official document to ascertain their regained legal identity. The first urgent need for citizens was to be able to exchange rubles, the Soviet currency, into Estonia's new national currency, the kroon.¹² For this purpose, family lists were prepared and recorded, which included the names, sex, date of birth, and residence of each member of a family, including the children.¹³ Later, these lists would become the first population records of the Republic of Estonia collected since the 1940s.¹⁴ A second pressing reason people had for an identification document was to be able to leave the country. After years of not being able to travel abroad, people in Estonia wanted to travel, which required them to have a passport. The first official passports after Estonia regained independence were issued in July 1992, and within a three-year period, almost all Estonian citizens had been issued a passport. However, people without Estonian citizenship had to wait four years, until 1996, when the Estonian Government began to issue identity documents to persons who had previously held Soviet passports.¹⁵ In the early 1990s, one third of Estonia's population held citizenship other than Estonian, most of whom were Russians who had migrated during the Soviet period.¹⁶

2. Design and early implementation (1992–2000)

An initial element in the evolution of the system was the early introduction of a personal identification number. In 1990, the standard of a personal identification code (PIC) based on the date of birth, gender, and a number based on daily number of births, was established which provided the crucial platform for the successful launch of the Population Register (PR). Since the middle of 1991, personal identification codes were assigned to all Estonian citizens, but particularly important, they were assigned to all children at birth. The PIC was also included in the first round of passports that were issued in 1992. While the contemporary legal basis for issuing PICs and linking them to the PR was provided until 2000 by the Population Register Act and the Decree of Creation, Issuing and Delivering of Personal ID Codes, the preparatory work started years earlier (figure 3.1).

For instance, in 1993 the new act of public registries was initiated with a strong focus on data protection (Kulper, 2014). In 1995, the government passed the Decree of Administration of the Population

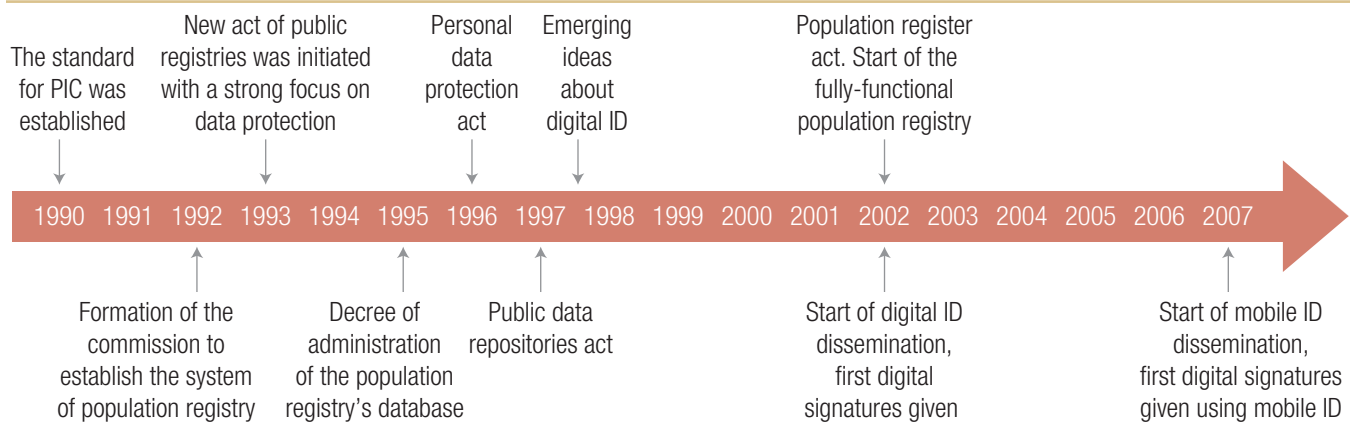
¹² In the summer of 1992, Estonia was the first Baltic country establishing a permanent currency. In order to avoid circulation of both currencies all rubles were exchanged to kroons at the rate of 10:1 between June 20 and 22. Each resident of Estonia, including children, was allowed to change 1500 rubles (Desai, p 2007).

¹³ Personal communication with Mrs. Mari Pedak May 2015.

¹⁴ By 1991–1992, when the independence and constitution referendum took place, there had already been an effort to register all Estonian citizens under the 1938 Citizenship Law. However, this registry did not include children, non-citizens, or citizens not residing in Estonia.

¹⁵ <http://estonia.eu/about-estonia/society/citizenship.html>

¹⁶ Since 1992, with the re-enactment of the 1938 Citizenship Act, which remained in effect until 1995, only pre-1940 citizens and their descendants were entitled to acquire Estonian citizenship by declaration. Everyone else needed to follow a process of naturalization. <http://eudo-citizenship.eu/docs/CountryReports/Estonia.pdf>.

Figure 3.1 ■ Timeline of Key Initiatives of the Integration of CRVS/ID System

Registry's Database,¹⁷ which regulated basic principles concerning the operation of the population registry. Since 1996, the Population Register administration has been effectively incorporated into the structure of the Ministry of Interior. In 1997, the parliament passed the Public Data Repositories Act, which designated the official start of the PR to be 01.01.2002. The Decree was replaced by the full text of the Population Register Act¹⁸ in 2000.

Further legislation was necessary to ensure that the collection of all personal data was conducted with safeguarding mechanisms in place, and that these mechanisms were normatively described by law. This process provided input for the Personal Data Protection Act¹⁹ that was eventually passed in 1996 (Kulper, 2014). This legal document explicitly defines what type of data is considered "personal" and enumerates the principles to which the administration and processing of this type of data must adhere. In 1997, the first concrete ideas began to circulate concerning the development of a digital ID-card. By 1998, a special committee under the Ministry of Interior was created for the development of an identification certificate and its technical specifications. The committee consisted of representatives of the public sector and a few private companies.²⁰ The idea was introduced to the public the same year, and the Ministry of Interior commissioned several feasibility studies on the technical specifications for the

digital ID-card. These studies included an initial study of the ID-card, identifying requirements of all parties interested in the ID-card, and research in the following areas: smart card standards, profiles and technologies, and international standards on ID-cards. The initiative was operationalized by organizing a technical working group to pilot development of an ID-card in a number of public agencies. Representatives from the Citizenship and Migration Board (currently the Police and Border Guard Board), banks, and private technical firms participated in this working group.

3. Roll-out and completion (2000–2005)

The first round of passports issued in 1992 expired after 10 years. When the time came in 2002 for every citizen to renew their passports, the legal foundations for implementing a national mandatory identification

¹⁷ The full text of the decree is no longer available. Metadata in Estonian is available at: <https://www.riigiteataja.ee/akt/925666>.

¹⁸ Full text available in English: <https://www.riigiteataja.ee/en/eli/518062014012/consolide>.

¹⁹ Full text available in English: <https://www.riigiteataja.ee/en/eli/529012015008/consolide>.

²⁰ http://www.id.ee/public/The_Estonian_ID_Card_and_Digital_Signature_Concept.pdf.

card and the Population Register were already in place. An initial database containing previous voting lists, passports, and family lists was used as the basis for the Population Register. By 2002, the Population Register was effectively established. The government benefited from the unique opportunity of the requirement for passport renewal to start rolling out the national ID-card, and data were recorded for first time in the newly established Population Register.

In October 2002, the first digital signatures were made using the new ID-card. It must be emphasized that the ID-card along with the mobile-ID (referred to in the next paragraph), provide the basic functionality of a functional e-government. The growth in the number of users with respect to the ID-card is provided in Figure 5.4 in Section 5. Electronic identification card. In 2007, the new mobile digital identification mode was introduced to the Estonian market. The service allows Estonian people to identify themselves using their mobile devices. In essence, the development of the mobile-ID is a further extension of the ID-card and rests on the same normative documents and principles.

Governance architecture

The population registration and ID systems are supported by various public agencies (figure 3.2). Among them are the Ministry of Interior, the Ministry of Economic Affairs and Communication, the Ministry of Justice, and the Ministry of Finance. Although there have been changes in the structure of the government and its responsibilities in the last 25 years, the Ministry of Interior today houses both the Population Register (within the Population Facts Department) and the National Identity System through the Police and Border Guard Board (Development Department). This Ministry constitutes the largest public sector organization in Estonia, and it coordinates citizenship

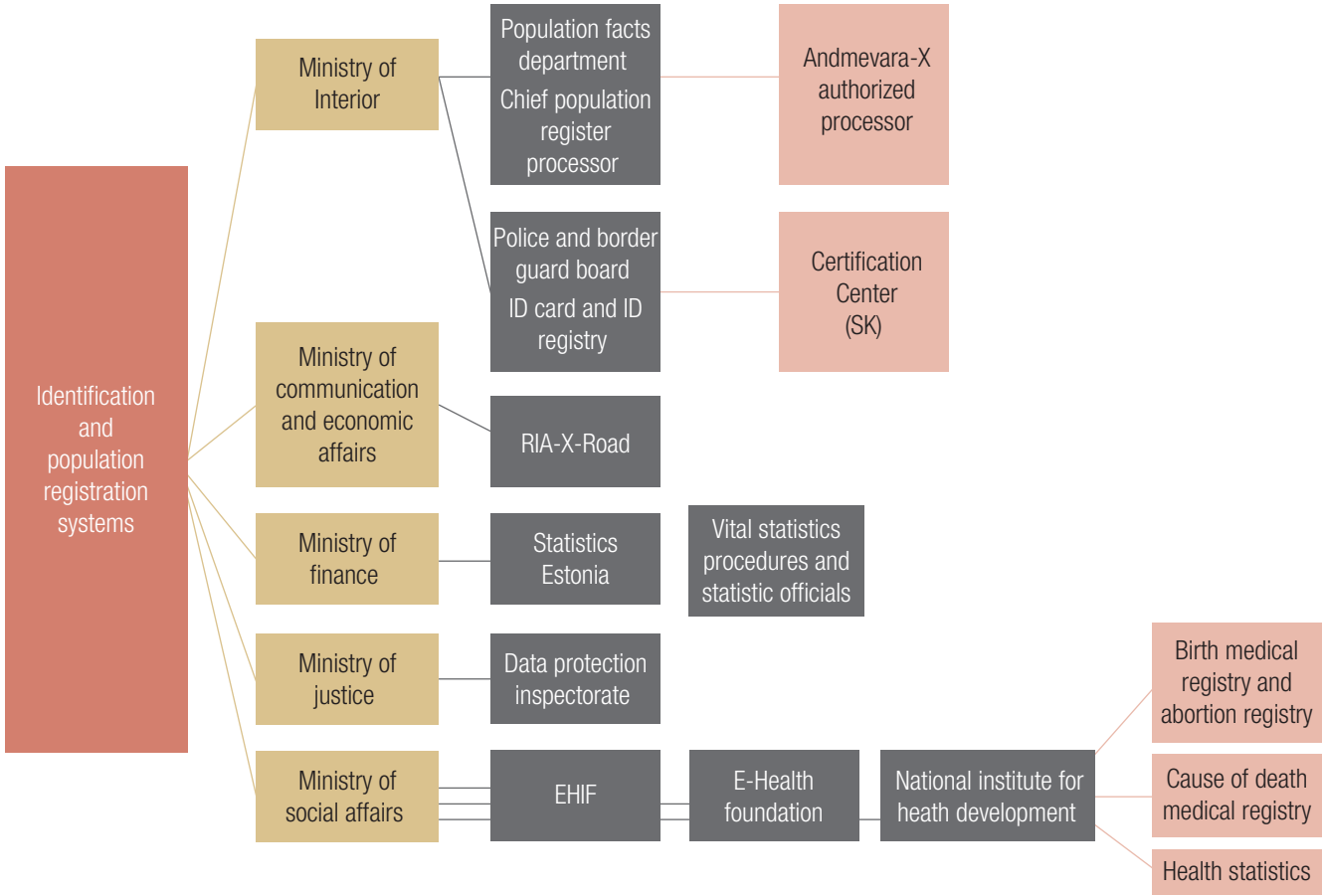
and migration issues, as well as issues concerning population and vital statistics, which are explicitly regulated by the Identity Documents Act and the Population Register Act. In addition, registrars of civil events (death, birth)—local and county governments fall under the authority of the Ministry of Finance,²¹ with the Population department working closely with them.

In addition to the Ministry of Interior, the Ministry of Communications and Economic Affairs is responsible for the bulk of developmental activities and implementation related to Public Key Information (PKI) infrastructure, as well as the standards and communications that make the system interoperable. The primary legal basis in this area is the Digital Signatures Act, which provides the framework for digital identification and signatures. The two key institutions under the Ministry of Communications and Economic Affairs that are in part responsible for the digital identity management are the Department of State Information Systems (an agency that is primarily in charge of policy-making procedures) and the Estonian Information System's Authority (RIA) (which is responsible for the development and maintenance of the state information systems). A unique exception to this institutional framework is AS Andmevara, a state-owned company that is responsible for the Population Register's software development, hardware maintenance, and customer management.

Statistics Estonia, under the authority of the Ministry of Finance, is guided by the Official Statistics Act and works in coordination with other public agencies. Among them is the Health Statistics Department in the National Institute for Health Development (NIHD).

²¹ Until September 2015, they were under the Ministry of Regional Affairs.

Figure 3.2 ■ Agencies Involved in the Population Registration and ID System





4 POPULATION REGISTRATION AND REGISTER-BASED STATISTICS IN ESTONIA

Following the tradition of the Nordic countries, Estonia's population registration system was established on the basis of a population register (see box 4.1). These systems are known to produce up-to-date quality vital statistics, and to foster interconnection of registries, which permits multi-sectoral collaboration. The Estonian Population Register (PR) was not the exception—it was through the PR and the personal identification code (PIC) that public registries were able to connect through X-Road.

Box 4.1: Population Register

“A population register is a ‘mechanism for the continuous recording of selected information pertaining to each member of the resident population of a country or area making it possible to determine up-to-date information about the size and characteristics of the population at selected points in time.’” (UNSD – Population Registers)

Registration of vital events in the PR are provided in the Vital Statistics Act and carried out at vital statistics offices. These offices are under the responsibility of the Ministry of Finance, and as provided for in the law, can register births and deaths, certify marriages and divorces, and make name corrections in the PR.

Local and central vital statistics offices referred to under the law include the following:

- Rural municipality and city governments
- County governments

- Foreign missions of Estonia
- The Ministry of Interior

While the Ministry of the Interior (MoI) supervises compliance with the Vital Statistics Act, the Ministry of Regional Affairs has established the specific procedure for making vital statistics entries. Training of vital statistics officers is organized by the MoI and county governments. Birth and deaths are usually registered at the county level. However, rural municipalities and city governments register births and deaths when there is no county government in their territory, and they are compensated by the state budget for costs incurred (Vital Statistics Act (2007, P(3)).

Guiding principles of the Estonian population registration system

The Estonian Population Register (PR) meets the criteria for an efficient population register system. According with OSCE/ODIHR, (2009) these criteria include the following:

- Registration is mandatory for the entire population (citizens and legal residents).
- The population register is complete and includes citizens living abroad (excluding visitors and non-legal aliens).
- The PR is continuous and permanent. Different from a census, the PR collects personal data regularly, and is permanent under the law.
- Data protection measures are in place, data processing is legitimate, and data security is guaranteed.
- There is only one record per one person. The individual's personal data is registered in one place and one place only.
- Multiple uses are made of a single registration. There is a legal provision against multiple registration.

Population register: Structure and operation

The Estonian Population Register (PR) is a national register. It the largest data repository containing information on personal data, population composition, and family events in Estonia. It is a digital database containing entries on every Estonian citizen, and on every citizen of the European Union, Member States of the European Economic Area, or the Swiss Confederation who has registered his or her residence in Estonia, and on foreigners who have been granted residence permits or right of residence in Estonia. All the information contained in the PR is created and collected in the relevant legal registry of vital events (birth/death registration, change in place of residence, and so forth). The data are held permanently in the repository without any clauses for expiration. However, the paper records are kept for 110 years before being stored permanently at the National archives.

The PR contains the following information:

• Name	• Death information (place and time of death) and, if available, place of burial and cause of death
• Place and date of birth	• Marital status (single, married, widow/widower, or divorced)
• Sex	• Parent's right of custody and guardianship
• Personal Identification Code (PIC)	• Person who has restricted active legal capacity
• Citizenship status	• Family information for the person's mother, father, spouse, and children
• Place of residence	• Ethnic nationality, mother tongue, education, and area of activity, if they are submitted voluntarily
• Residence permit (in the case of foreigners living in Estonia)	
• Communication details (postal address, phone number, e-mail)	

The Estonian Population Register (PR) began operating in 2002 in accordance with the Population Register Act passed in 2000. As mentioned earlier, the initial information in the PR was taken from previous population registration databases and the Estonian

national electoral registers (citizen and aliens). It is important to note that all of these databases ceased to exist once the PR was established, and related data was transferred to PR archives.

The main purpose of the PR is to consolidate personal data for the government and local municipalities in order to allow these institutions to carry out their primary objectives. These objectives include the realization of a person's rights, liberties, and public duties. In addition, and according to the Population Register Act, the purpose of the PR is to keep track of the population accounts in the country. Among other applications, the data stored in the PR is used for organizing elections, payment of taxes, and other public duties if their performance is related to residency.

There are three key features of the PR legal framework that are worthy of mention:

1. Data must be recorded and stored in the same place where it is collected, that is, at the desk of the responsible vital statistics officer. This implies that there is no lag between the time of recording a vital event and storing it in the PR. Officially, the vital event is recorded when it is entered electronically into the PR and is digitally signed by the register officer.
2. Personal data contained in the PR should be used by every other public registry. Access to the primary data collection of personal data collected in the PR is forbidden to other agencies. This is a critical aspect of avoiding duplication of information and maintaining consistency.
3. The administrative supervision of the PR is exercised by a representative of the following bodies: Data Protection Inspectorate, the Ministry of Economic Affairs and Communications, and the Chief processor (Ministry of Interior).

Physically, the administration of the PR is located in the Ministry of Interior. The functions of development, maintenance, and customer relations are outsourced to AS Andmevara. As mentioned

earlier, the Population Register Act designates the Ministry of Interior as the chief processor of the PR. It also instructs the appointment of an authorized processor of the PR (which is outsourced to an external firm). The responsibilities of the processor include maintaining the PR, processing data, and ensuring its confidentiality. These functions are performed by the state-owned company AS Andmevara.²² About 17 people are involved at AS Andmevara who work exclusively with the PR.²³ The functional areas covered by the personnel of AS Andmevara are software development (requiring programmers, developers, and testers), hardware maintenance (system operators), and customer management (client relationship managers). The technical software is tailor-made for the PR. The platform on which the software is developed is the Progress Open Edge Relational Database Management System. This is a well-known platform for relational database management systems capable of handling large data storage and high-traffic loads, and is easily scalable.²⁴

The processing software is used on a daily basis by over 500 officials in local and county governments and embassies. The main application of the software is creating birth, death, marriage, divorce, change of name, place of residence registration documents. This division of functions aims at improving efficiency and task specialization.

The PR adheres to the key principles of guaranteeing personal safety and personal data protection. For that purpose, the Data Protection Inspectorate, jointly with the Ministry of Interior, supervises any violation

²² AS Andmevara is a state authorized company in charge of the hosting and technical development of the Population Register (www.andmevara.ee). In addition to supplying PR back-office services, AS Andmevara provides several IT-related services for the governmental sector.

²³ Personal communication with the head of the Population Register.

²⁴ For more information refer to: <https://www.progress.com/openedge/components/rdbms>.

to the requirements of processing data in the PR data protection. The Data Protection Act provides sanctions for any violation by the authorized processor, or by any other person or agency.

Annual operational costs of the Population Register are approximately 1 million euros (including VAT 20 percent), which includes administrative expenses, software maintenance, data extraction, and hosting costs. The costs have remained about the same for the last five years. This represents less than €1 per person per year. Development costs are not fixed and are highly dependent on specific needs and changes in the environment. For example, availability of funds from European structural funding, and changes in legislation, are the two most relevant sources from which changes in the PR's development costs could emerge. In 2015, the estimated cost for development is approximately 100,000 euros, but unlike the annual operational costs, it is not constant over time.

Funding for the Population Register is almost exclusively provided by the government's budget. A small amount of funding is provided through European structural funding and data sales. An example of a recent project paid by EU funds was the digitalization of old registries to complete family information. Another source of income for the PR is conducting surveys, such as socio-economic surveys that require reliable population data for constructing representative population samples for survey design. Similar applications generate a small, but steady income for the PR.

Birth registration

Birth registration in Estonia is mandatory, but it is also free. Parents are required to register births in the Population Register at their registration office within one month of the baby's date of birth.²⁵ However, the first incidence of registration (the medical birth certificate) is typically carried out by health providers, either at the hospital at the time of delivery, or during a post-partum check-up. This first baby record takes

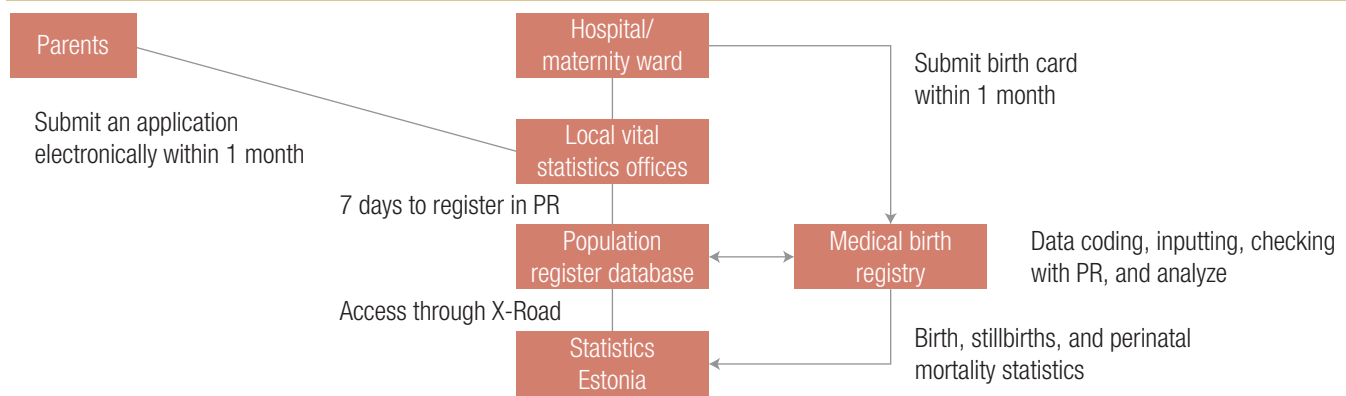
the form of a *birth card*, and this is the basis for the Estonian Medical Birth Registry (EMBR) (see box 4.2). The birth card is completed for every child (live or still-birth) born in Estonia. These cards are sent monthly in sealed envelopes to the registry. Information is gathered from all health institutions providing obstetric services in the country.

A key component of the birth card is the Personal Identification Code (PIC) that is granted to each newborn at the time of birth. The PIC is assigned to each baby based on its sex, date of birth, and a three-digit code indicating the order of the birth in the total number of daily deliveries. These codes change every day and are distributed to hospitals in lists. If the baby was not delivered at a hospital (this occurs in only a very few cases in Estonia), the parents need to ask a health provider to complete the birth card, or the vital statistics officer grants a PIC at the time of birth registration.

Figure 4.1 describes the birth registration path. To register a birth, parents need to submit an application to a Vital Statistics office. The officer has the obligation to register the birth within seven working days after the receipt of an application, but it is usually done the same day. Birth registration and creation of a birth certificate is free, but the cost for a duplicate certificate is €4. It is not required that the application be submitted in person. The application is submitted electronically and digitally signed, but should contain the following information requested for birth registration:

- Name
- Sex
- Date of birth
- Personal identification code
- Place of birth and citizenship of the child
- Personal identification code of the mother
- Personal identification code of the father
- Right of custody

²⁵ The law provides for a possible extension to up to two months. (Vital Statistic Act §3).

Figure 4.1 ■ Path of Official Registration of Births

The register officer tries to avoid duplicate input of data into the Population Register. By 2015, all hospitals have already implemented an electronic birth record, which allows intercommunication with the PR

using the baby's PIC. In those instances, in which each parent is already included in the PR, and their marriage has also been recorded, the birth registration can be done electronically and certified by the PR. However, one of

Box 4.2: The Estonian Medical Birth Registry (EMBR)

"The Estonian Medical Birth Registry is a database belonging into the state information system, which maintains information on live and stillbirths, epidemiological research on perinatal illness and mortality, organization of pregnancy and post-delivery health services, and birth statistics"—Public Health Act.

The birth medical register (EMBR) was introduced very early, after the middle of 1991, and includes data collected since 1992. Since the commencement of its operations, the information on each birth card received by the birth registry has been entered into a computer, creating a continuous database for health statistics (Anderson, 1994). The EMBR plays a significant role as a complement to the population registration data. "The data to be collected make it possible to **measure fertility in Estonia**. The gathered data are also used in epidemiologic **scientific research**, and for **organizing of post-delivery health services** and birth statistics" NIHD, 2014.

Since they were introduced, birth cards have included each infant's assigned Personal Identification Code (PIC). The use of the PIC both in birth and death registration has made it possible to link birth and death records, a feature that has been used regularly as a check between medical registries and the Population Register (PR). This connection also allows errors to be assessed and the completeness of legal records to be determined. Because the EMBR includes births from non-citizens and non-legal residents as well, it has a larger scope than the PR. A second reason the EMBR has provided additional value is the additional level of information collected in the registry. Unlike the PR, the EMBR includes background information about the mother and father, including: nationality; education; occupation; number of previous pregnancies, miscarriages, and induced abortions; and other characteristics. This information of the mother at the time of birth can help shed light on the factors affecting delivery and perinatal mortality.

At the EMBR, the following functions are performed (NIHD, 2014): data coding; input of data; control and correction of data (in cooperation with health institutions and the PR); standards data processing and data processing to requests; saving data and storing filled forms in archives.

the areas Estonia is still working on is the development of a national electronic birth registration. In particular, it is desirable that such a system be able to transfer electronically the medical birth records to the EMBR.

A key feature of the Estonian population-based registration system is compliance with registration. Almost all births are registered within the first month of life. This is due partially to a series of incentives in place to generate demand, but also because it is in the interest of parents to have the birth registered. In Estonia, once a birth has been registered in the PR, a paper birth certificate is not required for any state or local government offices. This is because all public databases are interconnected, and they use the data already contained in the PR. A birth certificate might be needed in the case of an institution that does not have an access to the PR, but in general, all services for the baby starting with health insurance and childbirth subsidies are linked to the birth's registration in the PR. Thus, registering a baby as soon as possible saves time and money.

Death and cause of registration process

Death registration is mandatory for every person who has died in the territory, as well as for Estonian citizens who have died abroad, and for persons whose latest residence was in Estonia. A death registration, certificate, and the determination of cause of death are provided for and regulated by two laws, the Vital Statistics Act passed in 2009 and the Establishment of Cause of Death Act, passed in 2005.

A death can be registered by any of the following members of the family at relevant institutions: spouse, relative, relative by marriage, person who was living with the deceased, head of an agency that provided health care service, police official, and other persons, who have information about the death. To register a death, an application should be filed with the Vital Statistics Office within seven days of the date of the death or the date on which the deceased person was found. Vital Statistics Office branches that are

responsible for registering deaths (similar to registering births) are the county government, local government or city government, and in Tallinn by the Harju County government or the Tallinn Vital Statistics Office.

In order to register a death, the following information must be submitted:

- Medical death certificate or court decision establishing the fact of death or containing a declaration of death
- Identity document of the deceased
- Petitioner's passport or ID card

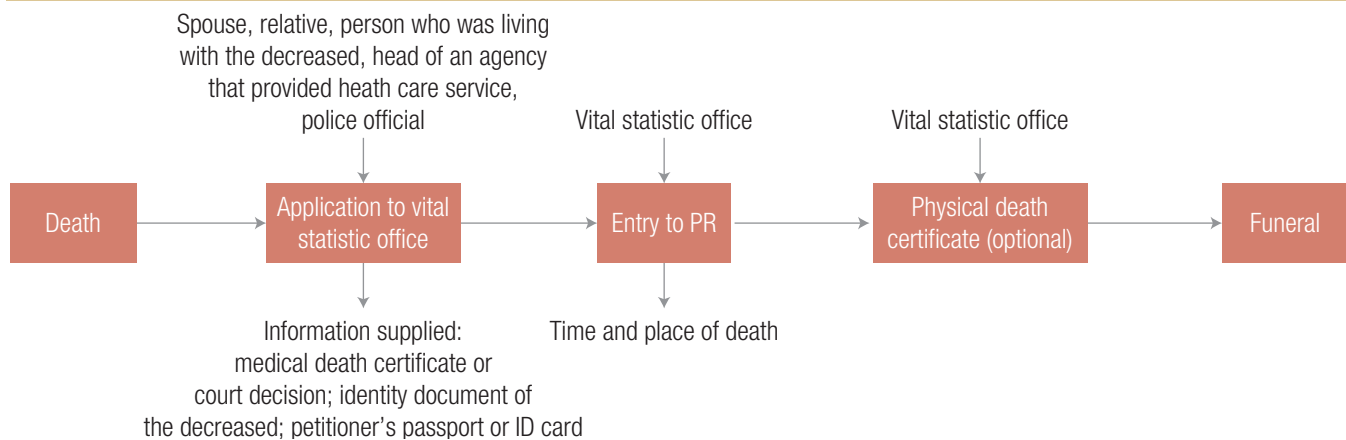
A death registration is prepared and the death certificate is issued by request. Registration of a death and the issue of a death certificate are free of charge. The burial of the deceased cannot commence prior to registration of a death at a Vital Statistics Office. As happens in the case of birth registration, the register officer updates the population register dataset with this information.

A diagram explaining death registration is depicted in Figure 4.2.

Establishing and ascertaining Cause of Death

The responsibility for ascertaining the cause of death (COD) rests with the medical practitioners who prepare the medical birth certificate. In cases where the cause of death is uncertain, or in cases of violent, suspicious, or sudden death, the law provides for the possibility of either a pathological or a forensic autopsy.²⁶ The cost of the pathological autopsy is financed by the Estonian Health insurance fund when the deceased

²⁶ When identification is not possible, police can use fingerprints for identification. In the 1990s there were about 200 cases of unidentified bodies; currently there are not more than 10 in a year, and a special person is in charge of looking after those cases. Personal communication with Mr. Gleb Denisov the head of cause of death registry.

Figure 4.2 ■ Path of Official Death Registration

person was a beneficiary, while the forensic autopsy is financed by the Ministry of Justice. Once the initial cause of death is established, the death certificate can be provided to the family. Doctors and health institutions are also obliged to send the medical death certificate to the Cause of Death Registry (CODR) (See box 4.3). This registry is part of the National Institute for Health Development, and it is under the governance of the Ministry of Social Affairs (MoSA). Based on the COD Act, the Ministry is the chief data processor for the COD registry concerning the causes of death.

Death and Cause of Death Registry

The COD registry has the goal of collecting and processing data to develop national social policy, to evaluate the population's structure and state of health, as well as to plan preventive actions in the social and public health area. It has been in operation since January 2008. Before 2008, the data on cause of death was collected by Statistics Estonia. The registry uses both information from the medical death certificate and information on the Population Register (PR)²⁷. Every week, data concerning recent deaths is downloaded by the CODR through X-road and encrypted. The information collected includes personal data names, personal ID numbers (sex and date of birth), date of death, and place of registration. In this way, once the

medical death certificate arrives by mail, the registry codes the COD using the sample of deaths registered in the PR. The data that need to be inputted are the cause of death, the WHO ICD-10 classification coding, and medical information included in the medical death certificate. This process saves time and the cost of digitalizing, which had required an extra person to do it. Currently, the registry has a budget of €50,000 that covers salaries for three positions, which include two medical coders, and the head of the registry, but it does not cover programming, which is the most costly activity.

The underlying cause of death is coded and processed in accordance with WHO standards using ICD-10, and a software program called IRIS is used for selection of underlying cause of death in the European Union. The registry conforms to the quality assurance criteria of the EU statistical body—EUROSTAT. The processing time is still slow, requiring about three months because the registry needs to wait for the medical death certificates to be sent. Once, the information is in the register, the process is very quick. Similar to the birth registry, the process could be much faster if an electronic death certificate system was in place.

²⁷ <http://www.tai.ee/en/r-and-d/registers/estonian-causes-of-death-registry>.

Development of this type of system was in the planning phase with the MoSA, but it has been postponed.

The interconnection between the PR and the CODR has allowed the identification of errors and ensured better data completeness. The information collected is published on the CODR website, but is also sent to Statistics Estonia, which reports mortality statistics as well. Other users who have been granted permission to use COD data are the Genetic Bank at the University of Tartu; the Research Institute of Epidemiology and Biostatistics; and The Institute for Population Studies at Tallinn University. Permission to use this data is obtained from the Ministry of Social Affairs in accordance with the Data Protection Act.

Best practices: Population-based registration system

At the base of some of these best practices are several challenges that Estonia faced and still needs to overcome. The first was only having a small public administration apparatus available to perform population registration functions. As a result, the government of Estonia designed a system that efficiently relies on electronic databases, inter-connection, and cooperation. The second challenge was to move from a citizen-only registration system to one covering the whole population. Achieving this aim required time and the establishment of a legal basis for its implementation, but more importantly, it also involved a change in the vision of the country.

Best practices	Description
Electronic and Central Population Register supported by both a chief and authorized processor.	Separating supervision and regulatory functions from operation and maintenance in the Population Register (PR) provides transparency, efficiency, and task specialization. By allowing outsourcing of ID card printing and chips, the small team in the Mol can focus on designing, developing, and ensuring data quality.
Registration of children at birth, and ensuring linkage of this data with maternal information.	Population registration in Estonia is designed to follow individuals throughout the life cycle. In contrast to a system solely dedicated to identification management, the PR plays a critical role in giving legal identities to children starting from birth.
The use of the personal identification code for registry interconnection, reducing duplication and allowing data quality checks.	The Population Register (PR) is used as the backbone of the linkages with other person-related data sources. The latter encompass the different health and disease registries, including the medical birth registry, the cause of death registry, the cancer registry, and so forth. This also involves interconnection with the health insurance database, and the population census.
Cooperation among agencies and clear definition of responsibilities and inter-agency collaboration.	The population registration system involves at least four ministries and a variety of different agencies, but with a sound legal framework, the allocation of responsibilities and collaboration related to all agencies involved works effectively.
Having a medical birth registry and a cause of death registry separate from the administrative population registry.	This separation allows the PR to limit the collection of personal data, without foregoing the richness of personal data for specific population, epidemiological, and medical studies. Under clear privacy protection laws, PR data are often used by myriad of private companies for better rendering their services to end-users. For example, polling companies use PR data to construct valid representative samples, marketing companies for direct mailings, insurance companies to update their databases, etc.



5

ESTONIA IDENTIFICATION MANAGEMENT SYSTEM

The structure and operation

Estonia has made significant progress in implementing an innovative and integrated identification system characterized by its interoperability to other cross-government systems. The national Electronic Identification Management System (eIDMS) is governed by the Identity Documents Act put into effect in January 2000. In accordance with the law, it is mandatory for all Estonian residents over 15 years of age to possess an ID card. Possession of an ID card is also mandatory for all aliens who reside permanently in Estonia (Identity Documents Act). This feature distinguishes the Estonian eIDMS from those of other countries, such as Finland, where the ID card is not compulsory. There are no sanctions for not having a card, but as expected, when the first Estonian passports issued in 1992 expired, most people applied for either the ID card only, or the ID card together with an Estonian passport, when renewing their documents in the period from 2002–2006. By the end of 2006, one million cards were issued.²⁸ Currently, the rollout of the ID card is complete and more than 1.25 million ID cards have been issued. A number of studies have suggested that some of the key contributing factors of the success of the Estonia ID system are innovative public procurement, public sector competencies and leadership, adequate funding and legislation support, and the development of information technology infrastructure.

²⁸ The Estonian ID card and digital signature concept. http://www.id.ee/public/The_Estonian_ID_Card_and_Digital_Signature_Concept.pdf.

The primary element in the system is the Personal Identification Code (PIC). This unique identifier has been the core element of the national identity system since 1992, following Estonia's full independence from the Soviet Union, when it was issued for people seeking to enter the system for first time (for example newborns and new residents). In 2002, the PIC had already been included on the country's ID cards and was recorded when the ID cards were issued and the data were collected in the identity documents database. This registry is checked for conformity with the Population Register (PR) and the information between both registries is shared. Hence, the PR contains information on identity documents as well.

Identification management is under the responsibility of the Police and Border Guard Board (PBGB) in the Ministry of Interior. The Board is responsible for running the day-to-day activities of identity management, including data management, issuance of documents, communication and demand generation activities, and the maintenance of supporting infrastructure. Like the PR, the eIDMS outsources ID card preparation and printing and uses a partner firm called Gemalto for these functions.

A constitutional right: Personal data protection

A critical legal figure in the Estonian identification and population-registration system is the Estonian Data Protection Inspectorate (EDPI). This legal body, established in 1999, is governed by the Data Protection Act (2006) and is the supervising agency of the Public Information Act as well. The primary goal is protecting individuals' constitutional rights to privacy, and ensuring the transparency of the activities of the State. The agency is under the governance of the Ministry of Justice. The director is appointed by the government after a competitive selection, as is the case for other senior civil servants. The nomination is made in consultation with the Parliament.

However, a distinct characteristic of the EDPI is its independence. The data inspectorate is founded on a commissioner model in which, despite being under the governance of the Ministry of Justice, the head of the inspectorate is independent. Therefore, the director has the authority to recruit all staff, and to determine priorities and work plans. Moreover, the director reports directly to a parliamentary committee and the Chancellor of Justice (EDPI, 2013).

The EDPI protects the fundamental principles for personal data protection that were granted by the Constitution in 1992. These rights are as follows:

- The right to obtain information about the activities of public authorities
- The right to inviolability of private and family life in the use of personal data
- The right to access data gathered with regard to oneself

Similarly, the Public Information Act allows people to see who has access their information. Authorized users need to register and mark every information request. The Data Protection Act is in conformity with the Council of Europe Convention 108 for the Protection of Individuals with regard to Automatic Processing of Personal Data and its Additional Protocol, and the Directive 95/46/EC of the European Parliament and of the Council (EDPI, 2013).

The EDPI has 18 employees, all of whom are civil servants. Its budget in 2012 was about €630 mil. This budget does not include IT development or management, which are covered by the Centre of Registers and Information Systems that also manages the Inspectorate IT component (EPDI, 2013).

Personal ID code (PIC)

The personal ID code (PIC), which is issued by the state through the Ministry of Interior, uniquely identifies people with permanent residence status

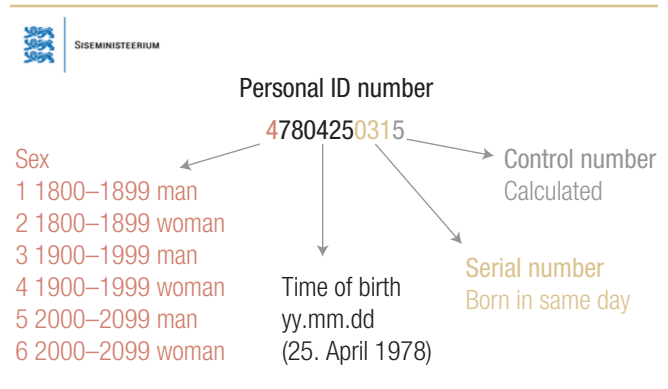
in Estonia. It is the only unique identifier used in Estonia; no other competing or alternative identifiers are available.

The standard for the PIC was developed as early as 1990 and has provided a crucial foundation for the successful launch and functioning of the Public Register (PR). Personal identification codes are formed for newborn children, foundlings, applicants for residence permits and right of residence, and citizens of the European Union, Member States of the European Economic Area and the Swiss Confederation upon first registration of their residence in Estonia. The PICs are formed as well for Estonian citizens with no personal identification code, and persons concerning whom a vital statistics entry is prepared.

For those born in Estonia, the personal ID code is assigned automatically at birth by the institution responsible for collecting and providing vital statistics (that is, the maternity hospital or the institution in charge of registering family events such as births, deaths, marriages, divorces, changes in postal address, and so forth). The communication between the authorized institution and the PR formerly was conducted off-line by conventional non-electronic means, such as using physical signatures and relevant forms. Since January 1, 2007, all PICs have been issued digitally using a special information system directly linked to the PR. The legal basis for issuing PICs and their linkages to the PR are regulated by the Population Register Act and the Decree of Creation, Issuing and Delivering of Personal ID Codes.

A PIC consists of 11 numbers as follows: the first number defines the person's gender and the century the person was born in; the second and third numbers are the year of birth; the fourth and fifth numbers are the two-digit month of birth; the sixth and seventh numbers are the day of birth; the eighth, ninth and tenth numbers represent the order number for those born on the same day; and the eleventh number is a control number calculated according to a specified standard (refer to figure 5.1 for a graphical overview of the composition of PIC).

Figure 5.1 ■ Personal Identification Code Structure



Source: Estonian Ministry of Interior.

Electronic Identification card (eID)

The Electronic Identification Card (eID) is not only a physical identification document, but also has electronic functions that facilitate secure authentication and legally binding digital signatures. Issued since 2002, about 1.25 million of these credit-card-sized personal identification documents are valid, allowing citizens to digitally identify themselves and sign documents or take actions. ID cards are compulsory for all citizens and they are equally valid for both digital and physical identification. Due to their convenient size –ID1 (they fit better than a passport into a regular wallet), they are more often than not the only identification document that people regularly carry around. Physically, they are valid for identification in Estonia, but more importantly, they are also valid for travel in most European Union, European Economic Area countries and Swiss Confederation. Thus, in addition to their primary functionality—digital identification—these ID cards are effectively used as replacements for traditional identification documents (see Figure 5.2).

Digital identity requires adequate certification and time-stamping services by a trusted authority. The eID card uses a double certificate standard (the authentication and digital signature certificates accessible via PINs). Authentication certificate is used when the ID

Figure 5.2 ■ Estonian Electronic ID-card

Source: Estonian Ministry of Interior.

holder wants to inform a service provider about his/her identity. By law a token plus knowledge (PIN1) is needed to authenticate a person. In this way a service provider will be able to decide whether such a person will be eligible to access the service or not. In case when a holder wants to express his/her will—authorize a bank transfer, sign an agreement or some other document but also any information in file format—a digital signature will be used. Access to digital signing process is available via using PIN2.

The certificates on the ID are the key features of the eIDMs and where the public-private partnerships have been so effective. In Estonia, ID cards are manufactured by Trüb and the software has been procured by Ministry of Economic Affairs and Communications. Certification is outsourced to the private company AS Sertifitseerimiskeskus (SK) established in 2001 by the two largest commercial banks (Swedbank and SEB Bank) and Estonian Telecom. SK is a key partner to Estonian state in issuing certificates to digital identity documents (ID-card, residence permit, digi-ID and mobile-ID) along with relevant timestamping services. It has developed a baseline software called DigiDoc which enables the usage of digital signatures, checking the validity of digital signatures, encryption of documents and data using personal digital ID. The authenticity of the certificates can be checked in real time as the public key of the Estonia eID PKI is

available publicly as certificates are considered a public benefit.²⁹

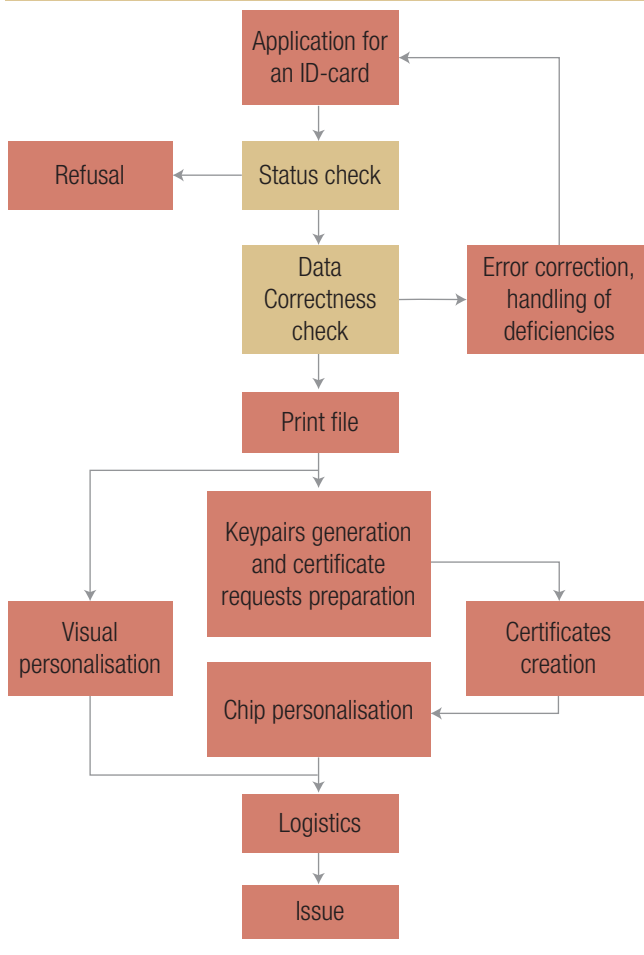
The application of the ID-card is initiated either in Service Offices of the Police and Border Guard Board (for domestic application) or in foreign representations of the Republic of Estonia by post or by email. Documents required for application include an application form that can be filled out either on paper or digitally, an existing identity document, a color photo and a document certifying the payment of state fee (about €25 depending on the age and status of the applicant).

The steps involved in issuing an ID card are (Figure 5.3)³⁰:

1. ID-card application in person, mail or by email when signed digitally
2. Eligibility check (data and documentation check). If ineligible the ID card is refused
3. Application information check and print order send over a dedicated data-exchange service. All steps along information on the civil servant involved in the process are captured in the information system
4. Card personalization when personal data is engraved in the card body and PKI key pair of authentication and digital signature are created and certification requests are sent to the Certification Service Provider (SK).
5. Certification Service Provider will create authentication and digital signature certificates and will send them back to the personalization where the certificates and personal data file will be stored in the chip of the card.
6. Personalized ID-cards are sent by PBGB courier to the service offices.

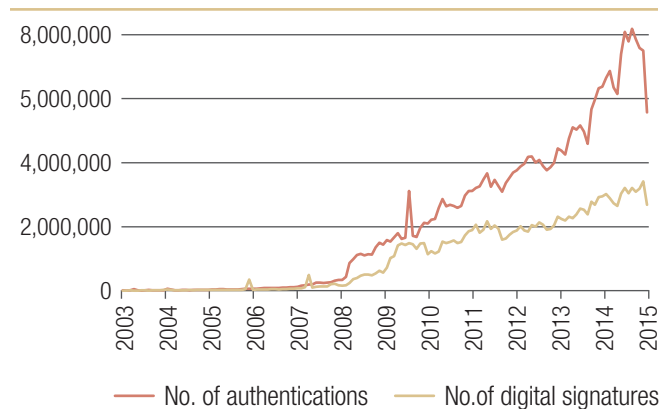
²⁹ ID software can be downloaded here <https://installer.id.ee/?lang=eng>.

³⁰ Figure and information provided by Mr. Helar Laasik – Chief expert. Police and Border Guard Board.

Figure 5.3 ■ Process of Issuing an ID Card

The ID-card is issued within 30 days in person in the Service Office or foreign representation office. The ID-card can also be applied to in expedited order within 5 working days.

The first ID-cards were issued in January 2002. By June 2015, digital ID-cards had been used approximately 353 million times for personal identification and 222 million times for digital signatures.³¹ The Digital Signature Act was passed on March 8, 2000, and it entered into force on December 15, 2000. The law regulates issues that are essential for implementing a nationwide Public Key Infrastructure (PKI) and digital signature infrastructure. A digital signature by law is the equivalent to a handwritten signature for any public or private document, and public agencies are now required to accept electronically signed documents.

Figure 5.4 ■ Growth of Digital Authentications and Signatures over Time

The average annual growth rate over 14 years (from 2002 to 2015) has been approximately 6.4 million authentications per year and approximately 3 million signatures per year. In other words, the growth rate for digital identification is about two times that of digital signatures between August 2012 and March 2015. (see figure 5.4).

e-Residency

Since May 2015 Estonia initiated a completely new form of digital identification—the e-Residency. The idea behind e-residency is to offer people from all over the world a means for digital identification and thereby grant secure access to leading digital services developed in Estonia, including the opportunity to give digital signatures in an electronic environment. The latter is legally compliant with the face-to-face

³¹ Digital signatures are regulated by the Digital Signatures Act. This act is available at the following online address: <https://www.riigiteataja.ee/en/eli/508072014007/consolide>. Also refer to the Identity documents Act: <https://www.riigiteataja.ee/en/eli/504112013003/consolide>.

identification and handwritten signatures in the European Union.

An e-resident is a physical person of any citizenship in the world who has received the e-residents digital identity. Digital identity is provided with the help of a smart ID-card that has no photo, but comes with the microchip with security certificates managed centrally by SK. The two factor identification, similar to the Estonian native ID-card, in combination of smart card reader and the small computer program allow the access to digital identification services. The latter comprise of digital signatures, launching and managing companies, do the online banking, encrypt files, etc.³²

The costs associated with issuing individual ID cards are as follows:

	PBGB service offices in Estonia	In foreign representation
Persons under 15 years of age;	7 €	10 €
Persons with moderate, severe or profound disability;		
A person who has attained Estonian general pensionable age		
Starting from age of 15	25 €	50 €
ID-card in expedited order	45 €	Cannot be applied

³² More information on e-residency is available at: www.e-estonia.com/e-residents.

Best practices: eIDM system

Best practices	Description
Mandatory	Compulsory identification in Estonia created the platform for universal identification. This purpose of identification was not population control, but to create a system in which the ID card was a key component for accessing public services. This would not be the case if not having an ID was seen to be discriminatory under the law.
Data Protection	Data protection is a system guiding principle achieved through the enactment of the Data Protection Act, and the establishment of a Data Protection Inspectorate dedicated to defend citizens' constitutional rights to privacy and access to public information, and to foster trust and transparency. The independence of the Inspectorate has been key for its supervisor role.
Security – double certificate	The eID card uses a double certificate standard (the authentication and digital signature certificates accessible via PINs). The certificates on the ID are the key features of the eIDMs and is an area in which public-private partnerships have been extremely effective.
The Public Information Act allows people to see who has requested access to their information. All authorized users need to register and mark every information request.	A key feature of the system has been empowering citizens with the potential to manage and control their own personal information, but it has also enabled them to obtain public information. Hence, the ability to track who has accessed their information, and acted upon it.
The ID card has a dual purpose, providing both legal identity and Identification for accessing services and supporting digital signatures	This double function has led the ID card to be widely used by the population facilitating the ID card take-up and generating demand at the same time.
Training and demand generation	Estonia carried out several activities to inform and assist the population in using the ID card and the internet. Some of these are focused on specific population such as the senior citizens.



6

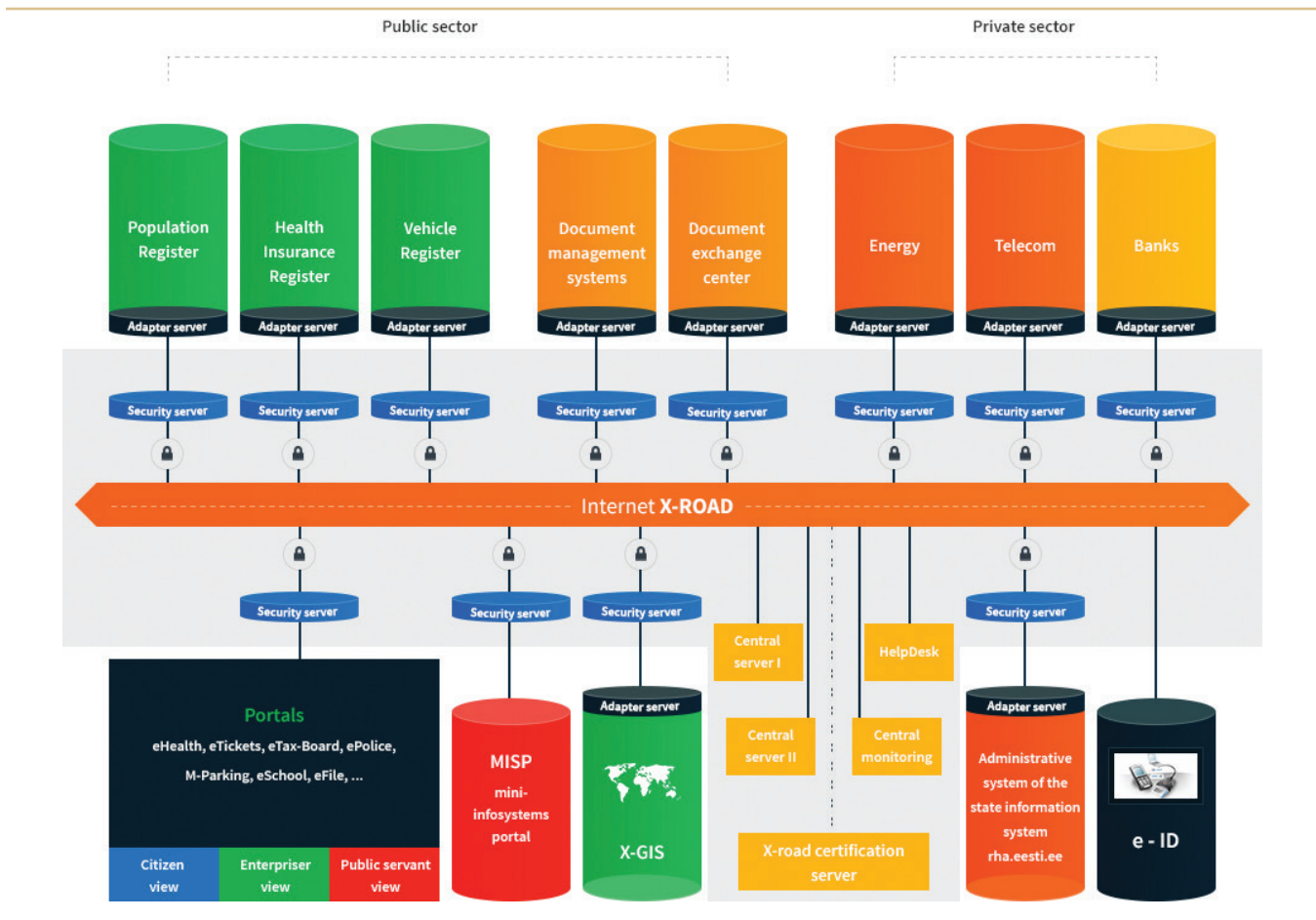
X-ROAD: THE BRIDGE BETWEEN PR, ID CARD AND SERVICE DELIVERY

In addition to the legal framework, and the introduction of a personal identification code (PIC), the interconnection between the Population Register (PR) and identification management systems (IDMS) was operationalized by X-Road—an innovative data exchange platform behind eGovernment. X-Road was introduced in 2001³³ and was originally designed to standardize the usage of public databases through a standardized interface over the Internet for information queries. Estonia had started developing public sector databases in the early 1990s, and the connection with other databases prompted individual ministries to develop their own interfaces. With X-Road, only one single solution was necessary to provide interconnection among governmental agencies. The development of this platform showed the advantageous role of public-private partnerships in Estonia. At least eight private companies, IT firms, and commercial Banks participated in the project.³⁴ Between 2001–2003 development cost was approximately \$2 million (Kalha, A, 2003). Over time, X-Road became an adaptable scaled-up tool that allows users to transmit large datasets, perform searches across several databases, and interconnect registries. In 2013, more than 2,000 services

³³ “X-Road is a technical and organizational environment, which enables secure Internet-based data exchange between the state’s information systems. Pursuant to the Public Information Act, the exchange of data with the databases belonging to the state information system and between the databases belonging to the state information system shall be carried out through the data exchange layer of the state information system. The X-Road platform allows institutions/individuals to securely exchange data as well as to ensure people’s access to the data maintained and processed in state databases.” <https://www.ria.ee/x-road/>.

³⁴ Softshark Ltd. Cybernetica Ltd., IT Meedia Ltd., Cell Network Ltd. Andmevara Ltd. Realsüsteemid Ltd AA Arendus Ltd. And commercial banks.

Figure 6.1 ■ Population Register (along with many other Registries) Supplies Vital Information to All Public E-services via X-Road



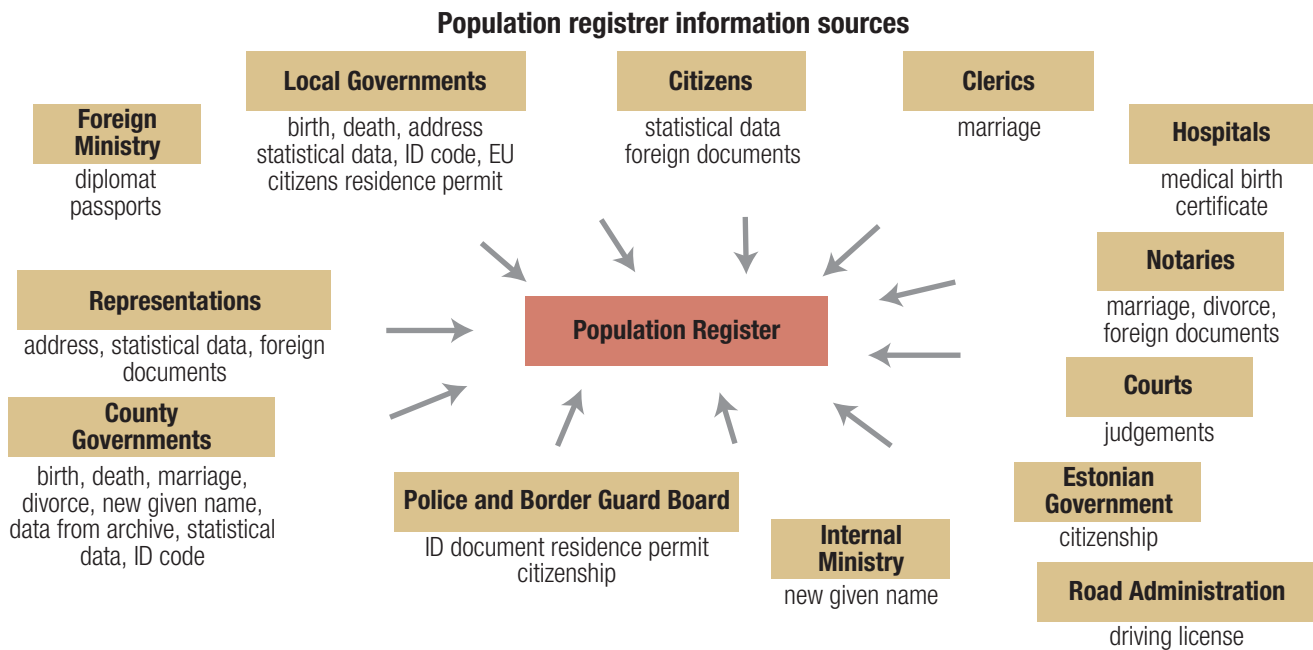
were provided using X-Road, more than 900 organizations used the platform daily, and over 170 databases, including both public and private, were used to provide services through it.³⁵

X-Road serves as a platform for application development by which any state institution can relatively easily extend their physical services into an electronic environment. For example, if an institution, or a private company for that matter, wishes to develop an online application, it can apply to join the X-Road platform and thereby automatically obtain access to any of the X-Road services. X-Road offers a seamless point of interaction between those extending their services online and a variety of state-managed datasets and services. The conceptual logic of the X-Road is depicted in figure 6.1.

One of the central benefits of X-Road is that it dramatically minimizes the necessity for repetitive data entry from the client side and enhances the reuse of data collected during previous interactions between the state and the citizen. In fact, Estonia's Public Information Act³⁶ prohibits the establishment of separate databases for the collection of the same data. Both implicitly and in practice, this results in state institutions not being able to repetitively ask for the same personal information if it is already stored in any of the data repositories connected to the X-Road.

³⁵ <https://e-estonia.com/component/x-road/>.

³⁶ <https://www.riigiteataja.ee/en/eli/522122014002/consolide>.

Figure 6.2 ■ Information Sources into Population Register

Source: Population Register internal proceedings.

In addition to citizen-state interaction, X-Road is particularly suitable for queries involving multiple agencies and information sources. For example, checking vehicle registration data requires data retrieval from the Population Registry and a vehicle registry—the two unconnected data repositories. According to the State Information System’s Authority, the conventional offline approach would require three police officers working on the request for about 20 minutes. With the X-road platform, the entire information retrieval is conducted by one police office within seconds. At the same time, citizens are not even required to carry their driving license or car registry documents with them because the information system that the police uses displays the status of these documents in real time.

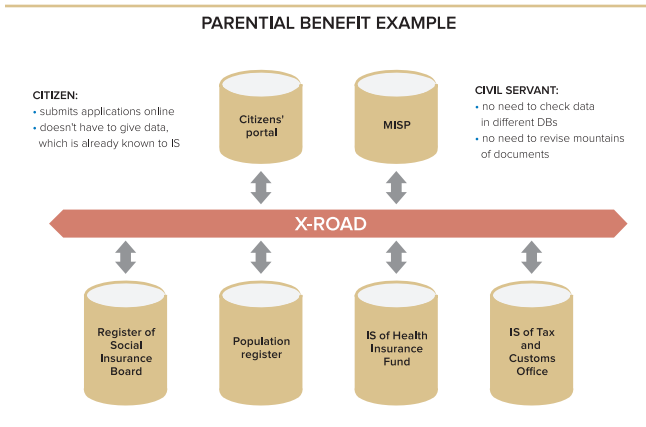
Naturally, this open design is accompanied by rigid security measures—authentication, multilevel authorization, high-level log processing and monitoring, encrypted and time stamped data traffic—the basic functionalities that are covered within the very structure of X-Road. In Figure 6.1 we depict the architecture of the X-Road system, where this data exchange layer

provides a standardized connection protocol of different data repositories from public as well as private sector to institutions that are interested in rendering their services online. Other vital components to Estonian e-services ecosystem, like public official portal (MISP), citizen front-end (ww.eesti.ee) as well as digital ID services are all linked into one seamless workflow through the X-Road data exchange protocol.

Population register and e-government services

The role of the Population Register (PR) in supplying public e-services to Estonian citizens is central. Prior to rendering almost any service over the Internet, almost all services require information stored in the PR. For example, by voting online, the voter’s list (those eligible to vote) is verified upon the data request to the PR. Similarly, checking a driver’s license by a police officer requires an information system to make a request to the PR in order to verify the resident status of a given

Figure 6.3 ■ Parental Benefit Application System



person. As the role of the PR is so influential in supplying public e-services, we illustrate its position within the entire ecosystem of Estonian e-services with three diagrams. First we look at agencies supplying information to the PR (figure 6.2); second we depict its position within the structure of X-Road that enables dynamic supply and development of e-services (figure 6.3); and finally we look at the specific example of processing parental benefit applications online (figure 6.4).

Figure 6.3 shows how many interfaces and datasets are jointly working to provide parents with

Figure 6.4 ■ Growth of Queries Made to Population Register over Time

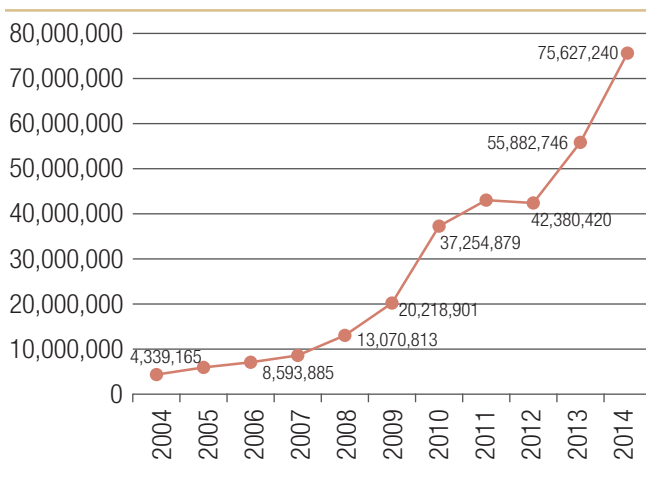
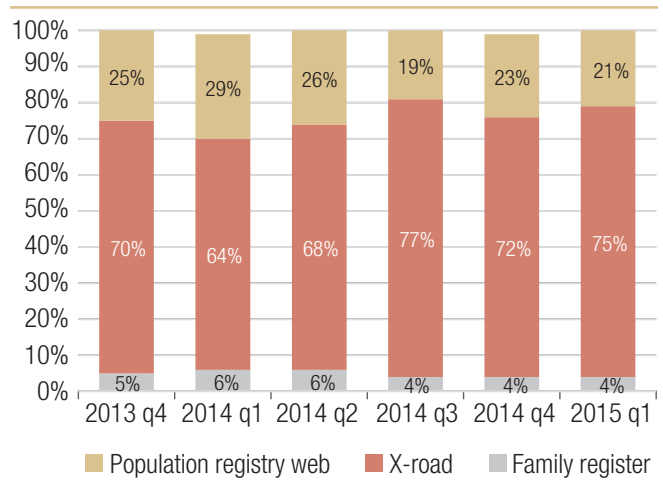


Figure 6.5 ■ The Share of Platforms Making Queries to the Population Register



an option to apply for a parental benefit.³⁷ As one can see, the citizen interacts with the government through the Citizens' Portal (which is the access point to most of the governmental e-services); the civil servant (if at all) works through the mini-information system portal (MISP), and the X-Road provides the access to all relevant data repositories that are needed to accomplish the goal—in this case process the parental benefit application.

Figure 6.4 indicates the importance of the Population Register in e-governance, and shows the nominal growth of queries made over time to it. As one can see, the amount of requests is quite modest in the first three to four year after which the amount of data supplied by PR exponentially increases reaching its peak value in 2014. Thus, the PR is not only a population repository, but it plays an important role in the delivery of e-services in Estonia. It is indeed at the core of the system e-services.

The dominance of X-Road in supplying relevant information to interested parties online is depicted in figure 6.5. It shows the share of queries that are made

³⁷ Retrieved from: https://www.ria.ee/public/x_tee/Xroad-technical-factsheet-2014.pdf.



to the PR by different sources indicating the dominance of X-Road. However, Family Register still generates sizable amount of traffic in its own right showing that data requests to accommodate personal information inquires has to be provided, too. For example, marriage, change of name, change of custody, registering a birth or a death, or

changing place of residence—are all the kind of request that are handled through the Family Register. The lowest share of traffic comes directly through PR, which is still non-negligible. The information requested from the PR directly is related to other services, such as health insurance, kindergarten enrollment, or social benefits.



7

KEY ENABLERS AND CRITICAL SUCCESS FACTORS FOR INTEGRATION

In understanding the Estonian success with system integration, it is important to note that neither the identification nor the population registration systems were conceived in isolation of each other. This is important because the holistic view that the government utilized in developing all these necessary components had the ultimate goal of improving public services delivery and ensuring public administration efficiency. Thus, the integration process followed a systemic view where all pieces had a function, and they operated in unison rather in isolation.

In addition to the good practices already mentioned, there were three main enabling factors that paved the path for system integration: sound and comprehensive governance and legal frameworks; the Public Key Infrastructure (PKI); and Public-Private Partnerships (PPP).

Governance and legal framework

Estonia's Identification Management System (IDMS) and Population Register (PR) are governed by sound legal frameworks. Good governance and stability have allowed Estonia to solidify the development of the IDMS and eGovernment with appropriate legislation. Therefore, while the fundamental principles of data protection, privacy, and mandatory ID cards did not change, the legal basis for them has evolved in parallel with the new digital solutions. Because Estonia was a pioneer in developing technological solutions, it was also a forerunner in establishing legal provisions required to back them up. Thus, the legal basis was designed to work seamlessly with technological solutions in Estonia. For example, when a new public e-service is developed and made accessible via the X-Road, one of the central benefits is that it

dramatically minimizes the necessity for repetitive data entry from the client-side, and enhances the reuse of data collected during previous interactions between the state and the citizen. For example, if a citizen's age is stored in the PR, her eligibility for voting, or driving, and so forth will be checked automatically. Clearly, while a simplified example, it shows how information stored in one repository can be reused by another. Moreover, Estonia's Public Information Act³⁸ prohibits the establishment of separate databases for the collection of the same data. Both implicitly and in practice it means that state institutions cannot repetitively ask for the same personal information if it is already stored in any of the data repositories connected to the X-Road. This is an example of interconnectedness between enabling technologies and regulatory acts designed to work for a common goal—better citizen-state interaction.

Table 7.1 lists the norms most relevant with regard to the Estonian IDMS and jointly provide the foundation for digital identification and authentication.

Information technology and Public Key Infrastructure (PKI)

The Government of Estonia played a critical role in facilitating the use of the Internet and information and communication technology (ICT), which enable the development of digital solutions, the use of an electronic card, and the application of X-Road. The Public Key Infrastructure (PKI) penetration in Estonia is over 80 percent as follows:

- Internet banking: 99 percent
- Mobile penetration: >100 percent
- 1000+ free Internet access points

The largest public-private partnership project in Estonia to this day is the Look@World project started in 2001. As an outcome, more than 100,000 individuals, that is, about 10 percent of the Estonian adult population, were taught to use and understand ICTs. The project

raised the number of public Internet access points from 200 in 2001 to about 700 in 2004. Through the years, the consortium worked hand-in-hand with the public sector, and in 2001, Look@World consortium members agreed to facilitate the widespread use of ID-cards. Later, in 2002, private banks were given the right to deliver digital ID-cards in their offices. Effectively, the choice to steer the country toward the new technologies was a political one, but it was also supported and funded by the private sector in the early days.

Since technology is the primary enabler of e-governance, the critical question is how to ensure secure communication between scattered government databases and institutions that use different procedures and technologies to deliver their services. Estonia's solution to this problem was to develop the X-Road, a secure Internet-based data exchange layer that enables a state's different information systems to communicate and exchange data with each other. Estonia has also become well known for both fostering a strong digital economy, while at the same time providing robust protections for citizen rights. E-government services have made Estonia one of the world's most attractive environments for tech firms, start-ups, incubating online powerhouses, and others. Furthermore, Estonia's success has made it a strong example of the importance of establishing the strong political will and leadership necessary for pursuing these type of reforms. Among the associated benefits of technology that Estonia showed are:

- Adoption of rigid security measures for technological applications—authentication, multilevel authorization, high-level log processing and monitoring, encrypted and time stamped data traffic
- Linkage of PIC and PR as foundational systems, via the 'X-Road'-type of middleware, to a variety of public applications to allow institutions to develop their own services independently without repetitive data collection

³⁸ <https://www.riigiteataja.ee/en/eli/522122014002/consolide>.

Table 7.1

Category	Description	Legal document
Information /data	<p>The legal framework stipulates who is responsible and who can access the data.</p> <p>In addition to technology and architecture, Estonian IDMS is strongly regulated by legal instruments that provide framework for security and protection of personal data. Moreover, these norms regulate the process by which institutions, individuals, and companies can request and receive access to information stored in government databases.</p>	<p>Public Information Act (2000)</p> <p>Data Protection Act (2006)</p>
Data protection	<p>The aim of this Act is to protect the fundamental rights and freedoms of natural persons upon processing of personal data, above all the right to inviolability of private life. This Act provides for: 1) the conditions and procedure for processing of personal data; 2) the procedure for the exercise of state supervision upon processing of personal data; and 3) liability for the violation of the requirements for processing of personal data.¹</p>	Personal Data Protection Act (1996)
Mandatory identification	<p>This Act establishes an identity document requirement and regulates the issue of identity documents to Estonian citizens and aliens by the Republic of Estonia. An identity document) is a document issued by a state authority (Ministry of Foreign Affairs (Diplomatic Passport), Police and Border Guard Board (all other identity documents)) in which the name, date of birth, personal identification code, a photograph and the signature or image of signature of the holder are entered.</p>	Identity Documents Act (1999)
Access to public information	<p>The purpose of this Act is to ensure that the public and every person has the opportunity to access information intended for public use, based on the principles of a democratic and social rule of law and an open society, and to create opportunities for the public to monitor the performance of public duties.²</p>	Public Information Act (2000)
Population registration	<p>This Act provides for the composition of data in the Population Register and the procedure for the introduction and maintenance of the Population Register, processing of data and access to data in the Population Register, entry of data on residence in the Population Register and exercise of supervision over the maintenance of the Population Register.³</p>	Population Register Act (2000)
Digital signature	<p>This Act provides the conditions necessary for using digital signatures and digital seals, and the procedure for exercising supervision over the provision of certification services and time-stamping services.⁴</p>	Digital Signatures Act (2000)

¹ <https://www.riigiteataja.ee/en/eli/512112013011/consolide>.

² <https://www.riigiteataja.ee/en/eli/514112013001/consolide>.

³ <https://www.riigiteataja.ee/en/eli/516012014003/consolide>.

⁴ <https://www.riigiteataja.ee/en/eli/530102013080/consolide>.


- Development of means for digital identification of citizens, including compulsory digital identification
- Introduction of digital ID followed by active, not passive, efforts to provide services to boost the usage and benefits of digital-ID.

The role of Public-Private Partnerships (PPPs)

Public-private partnerships (PPPs) have played an essential role in innovation and technology development in Estonia. These partnerships have allowed

growth in areas where large investments are required, but where public resources are scarce. For example, the government achieved universal connectivity through a concession agreement with the Estonian Telephone Company that focused on rural areas (Figueres-Olsen, José María, and Fiona Paua 2003). In the area of ID and eGovernment, there have been key partnerships with the private sector to develop digital solutions for the eID certification chip, the management of digital signatures, and more importantly, the development of X-Road. Without the participation of ICT and iTech

firms in supporting a data exchange layer platform, eGovernment would not be possible. In addition to initial technological developments, private companies have continued to support the development of modules for X-Road for public agencies. The transfer of technology has been also possible due to these PPPs. In terms of implementation, the printing and the chip for the ID card are outsourced to a private company. Estonia does not have specific rules to regulate PPPs, but all are managed through the Public Procurement Act.



8

APPLIED CASE: IMPROVING HEALTH CARE DELIVERY THROUGH AN INTEGRATED IDENTIFICATION SYSTEM

Overview of the Estonian health system

Estonia's health care system is composed of the Ministry of Social Affairs and its agencies, the Estonian Health Insurance Fund (EHIF), the Health Board, and the National Institute for Health Development (NIHD). The Ministry of Social Affairs plays a central role in developing national health plans, overseeing the adoption of national legislation, establishing regulations, and ensuring quality assurance controls for the whole sector. In conjunction with the Ministry, the EHIF, as the major purchaser of services in the country, plays a significant role in controlling health care costs, and ensuring adequate access and quality assurance across contracted providers.

Estonia's health care is based on a compulsory social health insurance scheme, built on the principle of social solidarity. As a result, health care is provided irrespective of a person's capacity to pay, social contributions, or status. The scheme finances an established publicly funded package of services through social contributions in the form of payroll taxes (about 13 percent). Uninsured individuals without

a labor income or social contribution have access to health services supported by an additional state contribution. The EHIF operates the national compulsory health insurance scheme since 2002 covering 95 percent of the population.³⁹ Both public and private health care providers are contracted by the EHIF.

Health service delivery in Estonia is organized around primary health care—a primary doctor that serves as gatekeeper for secondary and tertiary levels of care. In general, a primary health doctor can have between 1500 and 2000 patients in their area. Secondary and tertiary care are provided in private clinics, polyclinics, and hospitals. All hospitals in Estonia are established as limited liability companies, mostly owned by municipalities or the State. Today, Estonia's health care system comprises about 74 hospitals, and a ratio of 78.6 primary health doctors per 100,000 habitants.

The financial crises in 2008 prompted a series of structural and organizational reforms, including making primary health care the center of service delivery, and reorganizing the hospital network. The hospital reform aimed at reducing the number of hospitals inherited from the Soviet period, increasing bed occupancy levels, and reforming other type of hospital services, such as long-term care. Today, Estonia has reached European levels in inpatient indicators, but the focus is still on improving the use of the current infrastructure, improving patient pathways and quality of care.

ehealth: an integrated health information system

Estonian health system information system (EHIS) is governed by the Health Services Organization Act and it is under the authority of the Ministry of Social Affairs. Several institutions are involved in its operation including: the Ministry of Social Affairs, Estonian eHealth Foundation—developer and administrator of the National Health Information Exchange (HIE) platform; the Health Statistics Department (HSD) at the NIHD in charge of health statistics in Estonia, as well as

the EHIF and five health-related registries (birth, COD, Abortion, Cancer, Tuberculosis and Drug treatment)⁴⁰.

The EHIS collects information from patients and providers (public and private) through various channels. At aggregated level⁴¹ it receives information from registries and health care providers which are obliged to file quarter and annual reports on services provided as well as health inputs. On the other hand, the system compiles information at patient level, through the ehealth solutions (e.g. electronic medical records). The health information system is overall a central repository containing patients' and providers' health data, and as such personal data privacy and security are critical⁴². Here, the integration of eIDMS and PR have demonstrated being central. For instance, X-Road is used to exchange information in the system with external parties and accessing the data portal requires the two-factor authentication method (ID-card and PIN). Furthermore, all inquiries in the system are recorded based on personal ID and logs are recorded for all activities, and digital signature or digital stamp is necessary for all medical documents preventing changes or modifications.

The interface of IDMs and the population register is also playing a significant role in integrating the country's health information system. Having

³⁹ All Estonia citizens and legal residents are eligible for health insurance.

⁴⁰ The Health Protection Inspectorate, Social Insurance Board, State Agency of Medicines and Statistics Estonia are likewise providers and users of the information system.

⁴¹ Since 2008, health service providers are obliged to provide information on services provided and inputs. The Health Statistics Department compiles, processes and analyses aggregated information in regular basis of 1,400 health care facilities which provide quarter and annual reports to HSD via an internet-based data compiling system. This allows for aggregated data statistics on morbidity, service delivery, and inputs of the system. Yearbook of the Estonian eHealth Foundation, 2014, <http://www.e-tervis.ee/images/stories/eng/yearbook/2014/Yearbook2014.pdf>

⁴² For a complete review of ehealth services please see the yearbook of Estonian e health Foundation, 2014.

e-Prescription in Estonia

Electronic Prescription (e-Prescription) was launched in 2010 with the objective of making digital prescriptions possible for every doctor, and ensuring every pharmacy in the country could process electronic prescriptions. The project was developed by EHIF took five years and involved several stakeholders (hospital managers, GPs, private sector, pharmacy software companies). Currently 99% of all prescriptions in Estonia are electronic, and it is considered the most popular eService in the country.

Issuing medical prescriptions have benefited patients, providers and pharmacies. Before the system was implemented, patients were required to pick up refill prescriptions or those prescribed by telephone at doctor's office. Using standard electronic data exchange environment have allowed medical practitioners to submit the prescription to a central prescription center. The e-prescription is then immediately accessible in every pharmacy on a patient's request. Patients can then pick up their prescriptions directly in the pharmacy using the ID-card reducing the opportunity cost of traveling to the doctor office, but also have contributed to a more transparent prescription process. Patient can actually see the log-file for every prescription, and electronic information promotes monitoring and better prescription habits.

Doctors, on the other hand, have the possibility of checking patient's medications history (for all providers) and have access to the automatic calculation of the correct rate of reimbursement on medications compensated by the Health Insurance Fund. The family doctor can also automatically check the health insurance status of the patient by making a relevant query to the Population Registry. This query at the same time retrieves relevant personal information for the PR and automatically fills in the required fields in the e-prescription formula without the need to complete additional documents or submit again any of the information already stored in the PR. The pharmacy simply retrieves the prescription from the e-health system and reports back to the system that the medication was delivered to the patient. Because part of the form has been already filled by the doctor, the prescription is almost ready for e-invoicing by the EHIF. The entire process is conducted online using the digital ID card without any need for using paper-based documents

a unique ID serving as well as unique patient ID permits following patients through their clinical pathways allowing timely exchange of vital information across different providers and avoiding duplication of tests. This interface has been extremely useful in the eHealth environment. The nation-wide health information exchange platform was initiated in Estonia in 2005 after the Ministry of Economic Affairs allocated structural funds to develop four ehealth projects:

- Electronic Health Record (EHR) (1.6 mill €)
- Digital Images(0.2 mill €)
- Digital prescriptions(0.2 mill €)
- Digital registration(0.24 mill €)

The development of these eSolutions was gradual (2005–2008) and was accompanied by the creation of the

eHealth Foundation—a separate agency responsible for developing ehealth services and for managing the EHIS and its associated database and data exchange system. Currently, 98 percent of the population have documents in the electronic central system, whereas 750,000 people's information have used by medical personnel. The number of providers feeding information has been increasing—in 2014 an estimated 86 percent of doctors forwarded information to EHR. However, the system is still working in improving patients' usage, quality of data provided by general practitioners, and data retrieval and view.

Estonia's health care system has capitalized on the eservices platform part of the eGovernment⁴³. The electronic health record that was initiated in 2008, along with other e services such as digital image of clinical tests,

⁴³ <https://www.haigekassa.ee/en/digital-prescription>.

e-Consult, the possibility to have a health certificate delivered to the patient and the recipient institution, and e-prescription⁴⁴, have increased efficiency by limiting the administrative load of doctors, accessing time-critical information, and automating data collection.

Interconnection of the health insurance registry and the population register

The EHIF participates in the eGovernment platform by providing e-services. It also collects patient information in a specific registry—the Health Insurance Registry. This dataset is accessed via X-road. Patients are allowed to check their information in the registry using their Electronic Identification Card (eID) and authentication. They can review their past doctor visits and current prescriptions, control which doctors have access to their files, and receive answers to general health requests. They also can determine who has access to their health record information, and review their health insurance status. Each person with health insurance coverage is included in the registry. The database is updated every night with Population Register (PR) information. This means that births, deaths, and new enrollments are captured by the system on a daily basis. This has resulted in many benefits and improved efficiency. For example, as opposed to other systems, the EHIF based its budget on coverage and number of beneficiaries. Through this project, they have the possibility to have accurate and current estimates of population, size, needs, and demand of services.

Health insurance since birth

More importantly, this connection with the Population Register (PR) through X-Road has enabled the social

protection of children from birth. Since the PR connects with the EHIF dataset to communicate new births and deaths, all new births recorded in it are automatically included in the list of EHIF beneficiaries. This allows uninterrupted and regular access to health services. It also provides an incentive for parents to register their children since this facilitates obtaining pediatric care.

This is only possible because the EHIF is authorized to have access to the PR through X-Road. Patients' personal information, such as age, gender, address, and parents' information for children, are obtained from this source, thus avoiding duplication of information in the registry. The PR, however, is not allowed to obtain information from the EHIF registry.

Some additional benefits of the integration are as follows:

- Cost-savings have resulted from having complete registries, avoiding duplication of information, and facilitating the identification of families for health insurance.
- The EHIF registry also plays a role with other social benefits, such as unemployment benefits and sick leave. In these two cases, having the EHIF connected with other databases has allowed double proof. Most importantly, it has resulted in a less time-consuming process for individuals and organizations. Paperless administration has allowed a more efficient use of resources and time.
- Use of EHIF and X-road have also allowed for a better flow of the information on the health system, and they have been integrated into the operation and administration of the agency. For example, doctor salaries and hospital reimbursements or claims are managed through the system.
- The ID is not just a tool or instrument for patients, but it also serves as an ID for providers (public and private).
- Having a unique ID enables medical services to track patients across the clinical pathway, and to identify factors affecting quality of care and health outcomes. In countries without a system of unique identifiers, patients receiving care from different providers and organizations are not accurately identified. This practice leads to inefficiencies along the continuum of care, including fragmented health records, disrupted disease control, and limited health planning.



9

LESSONS LEARNED

- The first lesson we can learn from Estonia's experience is that the integration of systems is not an automatic or immediate process. On the contrary, it took the country about 15 years to develop such a successful unified system. At the time of regaining its independence, Estonia faced many similar challenges as did other former-USSR countries. Among them were the need to provide a new national identity document, to develop the national ID and population registries, to improve public administration and its information system, and to make public service delivery more efficient. The Government of Estonia, still, realized very early on that innovation and reliance on appropriate legislation were important to give Estonia a good start. Thus, investing time in laying out a legal basis for the initiative, carrying out consultations and establishing guiding principles and goals became the system most important strength.
- Among this guiding principles, Estonia bestowed special importance to the protection of the fundamental rights and freedoms of persons upon processing of their personal data. Thus, the government worked on ensuring that the public and every person has the opportunity to access information intended for public use, based on the principles of a democratic and social rule of law and an open society. It also ensured that each individual has control on their own personal information and ensure a clear and legitimate purpose for sharing information. This feature not only empowers the citizen but also generates a sense of accountability and trust in the system. Estonia's case shows the numerous benefits that a unique ID can have by guaranteeing data protection and safety.
- A very important aspect of the Estonian ID system development to consider was the gradual chronological order in which the different components were created. For instance, the initial introduction of the unique ID number facilitated the establishment of the Population Register. By entering this valuable information on each person in only one record, introducing ID cards was relatively straightforward, as well as the ID-mobile and e-residency. The

PR, unique ID and the ID card permitted the development of a data exchange platforms such as X-Road.

- Estonia's experience demonstrates not only the importance of having a unique ID for integration, but also ensuring interoperability across public databases. The principle of storing data where is collected, rather than attempting to gather all information in one place creates the possibility of systems' integration when resources are limited. Estonia exemplifies the possibility and benefits of establishing a secure, efficient, and integrated system without the need for a master database or data warehouse or just one single responsible and supervising agency, and without the need for expensive technology.
- Another lesson extracted from Estonia's experience is given proper attention to processes rather than focusing exclusively on outcomes. For example, Estonia worked in providing an

explicit process by which institutions, individuals, and companies can request and receive access to information stored in government databases. Also, learnt to be adaptable and make necessary adjustments to legislation and infrastructure, and to implement policies to ensure alignment with both the new technologies and with their related risks (for instance, cybersecurity attacks).

- Finally, public information infrastructure in Estonia is primarily service oriented and this feature created an environment where innovation and IDMS worked at unison. Overall, the value of innovation and technology in the ID system arises from the development of networks and the expansion of services to give access to the entire population. Consequently, the possibility of the system to connect the citizen with the government, and to put the user at the center of the system through technological innovation resulted in a remarkable unique system.



REFERENCES

- Anderson, B. A., K. Katus, et al. (1994). "Developments and prospects for population statistics in countries of the former Soviet Union." *Population index*: 4–20.
- Boughton, J. M. (2012). *After The Fall: Building Nations Out Of The Soviet Union. Tearing Down Walls: The International Monetary Fund, 1990–1999*, International Monetary Fund.
- De Bruin, A., J. Kardaun, et al. (2004). "Record linkage of hospital discharge register with population register: experiences at Statistics Netherlands." *Stat J UN Econ Comm Eur* 21: 23–32.
- Desai, P. (1997). *Going global: transition from plan to market in the world economy*, MIT press.
- Figueres-Olsen, José María, and Fiona Paua. "Crafting the Environment for Networked Readiness." *Global Information Technology Report 2003* (2002).
- Kalvet, T., Kalvet, T., Pihl, T., & Tiits, M. (2002). *Analysis of the Estonian ICT Sector Innovation System*. Institute of Baltic Studies.
- Kalvet, T. (2012). "Innovation: a factor explaining e-government success in Estonia." *Electronic Government, An International Journal* 9(2): 142–157.
- Katus, K., A. Puur, et al. (1997). Comparability of population data in previous USSR: case of Estonia. Tallin, Estonia R.U, EKDK
- Kerem, K. (2003). *Internet banking in Estonia*, PRAXIS.
- Kulper, K. (2014). Rahvastikuregistri kujunemine, andmed ja dokumendid. *Master thesis, University of Tallinn, Institute of Information Studies*.
- Lewis P (2006) Party systems in post-communist Central Europe: Patterns of stability and consolidation. *Democratization* 13(4): 562–583.
- Martens, T. (2010). "Electronic identity management in Estonia between market and state governance." *Identity in the Information Society* 3(1): 213–233.
- OECD (2011), *Estonia: Towards a Single Government Approach*, OECD Public Governance Reviews, OECD Publishing. <http://dx.doi.org/10.1787/9789264104860-en>.



OSCE/ODIHR. “Guidelines on population registration”. OSCE’s Office for Democratic Institutions and Human Rights (ODIHR), 2009

Robert SchwereArsala Deane, (2003),”Deploying e-government programs: the strategic importance of “I” before “E””, *info*, Vol. 5 Iss 4 pp. 10–19 <http://dx.doi.org/10.1108/14636690310495193>

Statistics Estonia (2013). Population and housing census 2011, Tallin, Statistikaamet (<http://www.stat.ee/phc2011>, accessed 29 October 2014).

Statistics Estonia. (2015). Every fifth person in Estonia lives in relative poverty [Press release]. No. 13, 29.01.2015. Retrieved from (<http://www.stat.ee/72511>).



WORLD BANK GROUP

1818 H Street, NW
Washington, DC 20433