Addressing the world – An address for everyone

The white paper

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Map of Paris, France (1615)

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Partners in the initiative

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Authors: Ms Colette Maritz and Mr Tobr Tenea

List of abbreviations

Mamelodi, Pretoria, South Africa

AFD	French Development Agency
AfDB	African Development Bank
AIMF	International Association of Francophone Mayors
AU	African Union
AUC	African Union Commission
BBR	Building and Dwelling Register
BPL	Below Poverty Line
CEB	United Nations' Chief Executives Board
CEN	European Committee for Standardization
CPR	Danish Population Register
CROSS SIS	Cross Border Spatial Information System with High Added Value
CUN	Metropolitan Government of Niamey
DECA	Danish Enterprise and Construction Authority
EAF	European Address Forum
EPOC	Tanzanian Electronic and Postal Communications Act
ESR	Danish Property Assessment Register
EU	European Union
EURADIN	European Address Infrastructure
EUROGI	European Umbrella Organisation for Geographic Information
FAC	French Aid and Cooperation Fund
FOSS/FLOSS	Free/Libre And Open Source Software
GINIE	Geographic Information Network in Europe
GIS	Geographic Information System
GNI	Gross National Income
GPG	Global Public Good
GPS	Global Positioning System
GSM	Global System for Mobile Communications
ICT	Information and Communication Technology
INSPIRE	Infrastructure for Spatial Information in the European Community
IP	Internet Protocol
ISO	International Organization for Standardization
ITS	Issue Tracking System
ITU	International Telecommunication Union
KYC	Know Your Customer
LBS	Location Based Service
LEP	Legal Empowerment of the Poor
MAE	French Ministry of Foreign Affairs
M2M	Machine-To-Machine (Communications)
MDG	Millennium Development Goal
MOPAS	Ministry of Public Administration and Security (Korea)
MoU	Memorandum of Understanding
NEPAD	New Partnership for Africa's Development
NGN	Next-Generation Network
NIDA	National Identification Authority (Tanzania)
OASIS	Organization for the Advancement of Structured Information Standards
PAC	Urban Development and Decentralization Project (Senegal)
PDUD	Urban Development and Decentralization Project (Mali)
PIDA	Programme for Infrastructure Development in Africa
PNVR	Permanent National Voters' Register (Tanzania)
PPP	Purchasing Power Parity
PSI	Public Sector Information
SDI	Spatial Data Infrastructure
STORK	Secure Identity Across Borders Linked
SIDA	Swedish International Development Agency
TCRA	Tanzania Communications Regulatory Authority
TOR	Terms of Reference
TPC	Tanzania Posts Corporation
TVEOM	Street System and Waste Tax
UDP2	Second Urban Development Project (Burkina Faso)
UIDAI	Unique Identification Authority of India
UN	United Nations
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN-Habitat	United Nations Human Settlements Programme
UNIDO	United Nations Industrial Development Organization
UPU	Universal Postal Union
WB	World Bank

Anna Tibaijuka

Foreword

When the Universal Postal Union (UPU) asked UN-Habitat to participate in its 24th Congress held in Geneva in 2008, it was clear to us, as urban planners, and particularly to me as Executive Director at the time, that we must promote the value of address infrastructure in our societies. Our work with urban inhabitants in developing countries that suffer from little or no urban planning and housing, particularly in informal settlements, has shown that the lack of an address can also mean the lack of legal identity, equal opportunities for employment and social integration.

This century is witnessing a fundamental change in our way of life; for the first time in history, half of the world's population lives in towns and cities. Urban areas are growing faster in developing countries, mostly through informal settlements, and our responsibility as local, national or international leaders is to make sure that nobody is left behind in this new urban era. We must do this by supporting urban development through all possible means in order to guarantee adequate living conditions and poverty reduction. We need new approaches for urban planning, management, financing and service delivery to ensure that the cities we create are socially inclusive.

Since the launch of the "Addressing the world – An address for everyone" initiative in 2009, the UPU has organized two conferences on addressing in 2010 and participated in a series of events that raised awareness of the value of address infrastructure as a key infrastructure of countries. These activities demonstrated unequivocally that it is almost impossible for individuals to be part of society without a legal identity, and that establishing such an identity often depends on having an official address. They also stressed that urban development, economic growth and the provision of basic services are inextricably linked to the existence of sound address infrastructure, in urban and rural areas alike. As a matter of fact, addresses appear to be a key element in aiding the delivery of policies at national and international levels in support of the Millennium Development Goals (MDGs), particularly with regard to governance, rule of law, poverty reduction, disease prevention and the provision of basic services such as electricity, sanitation and water.

Having served as a member of various commissions and professional associations that deal with the development and improvement of infrastructures around the world, I am convinced that the implementation of address infrastructure will result in improved public services such as sanitation, hygiene and water supply coverage, and many more fundamental services.

Today, initiatives such as the UPU's "Addressing the world – An address for everyone" help to inform governments of the advantages of investing in a national addressing infrastructure for the benefit of all. This white paper moves the initiative forward through an innovative analysis of the value of addresses through historical, economic and practical perspectives. This paper, prepared in cooperation with several UN organizations and other partners, supports the need for a better understanding of the role that addresses play in urban development. It may also help to create legitimacy for change; but more importantly, it provides a focus for intervention.

As the Minister of Lands, Housing and Human Settlements Development in Tanzania, I am particularly concerned about the problems inflicted by poor land tenure, deficient housing and unsustainable human settlements. As an African woman living on the world's fastest urbanizing continent, I am aware that we need to persuade everyone, from presidents to ordinary policy-makers, of the urgency of urban development issues. For this reason, I offer my full support to this initiative and I am honoured to serve as a special ambassador for this initiative. My hope is that the governments of member states and other agencies worldwide will commit themselves to this initiative aimed at improving addressing infrastructures, which in turn supports individual rights and sustainable cities.

Now is the time to act

Professor Anna Tibaijuka,
Minister of Lands, Housing and Human Settlements Development in Tanzania – Special ambassador to the "Addressing the world – An address for everyone" initiative

Preface

Edouard Dayan

What constitutes an address, and what does it mean to have one, or not to have one? Addresses serve as one of the basic facilitators of communication between people, public service institutions and businesses. Without them, it is difficult to reach individuals. It is difficult for governments and municipalities to deliver public services, and for businesses to operate effectively.

In most industrialized countries, physical – and, of course, electronic – addresses are part of everyday life. Just like roads, running water and health services, physical addresses are often taken for granted. Yet, in developing countries, physical addresses frequently exist only in major city centres. In such countries, many streets have no names and properties are not numbered. It is therefore difficult or impossible for public services and businesses to reach their target customers. For the postal business, an accurate and complete address is the key to providing quality service, so that correspondence, documents and goods reach their destination as quickly as possible.

The preamble to the Constitution of the Universal Postal Union (UPU) states that the UPU carries out its mission "with a view to developing communications between peoples by the efficient operation of the postal services, and to contributing to the attainment of the noble aims of international collaboration in the cultural, social and economic fields." In keeping with its mission, the UPU has been working to develop and improve national addressing and postcode systems around the world since 1999, especially in developing countries. Indeed, addressing is a key component of the Union's activities. However, addressing is not only about home mail delivery. It goes far beyond the postal sector and is essential for individuals, governments, the business sector and international organizations – indeed, for all of society.

A basic human right

Today, an address is considered part of a person's identity, and not only in the UPU environment. According to the United Nations Development Programme's Commission on the Legal Empowerment of the Poor, 4 billion people are excluded from the rule of law because they do not have a legal identity. This lack of identity is often a barrier to the enjoyment of their rights as citizens. Setting up an address infrastructure is one step towards tackling this issue.

Moreover, the last few decades have seen increasing population migration from rural to urban areas, resulting in an urban demographic explosion worldwide. This growth in both formal and informal urban settlements has made it increasingly difficult to locate people. An effective urban governance system is needed to ensure the social and environmental sustainability of urban settlements. Put simply, rapid urbanization means that people need addresses, a point that Professor Anna Tibaijuka, former Executive Director of the United Nations Human Settlements Programme (UN-Habitat), recognized in her message to the 2008 UPU Congress.

Access to services

There is no doubt that address infrastructure – the network of road names and house numbers – forms an important basis upon which society can function. The exact benefits of a nationwide address network are not easy to quantify, but the value increases dramatically when the network is considered as an infrastructure that enables access to other services. At the individual level, everyone needs an address to be recognized formally as a member of the community, to have access to property, to take on the rights and obligations attached to his or her social role, and to more easily participate in national and international markets. At the organizational level, local and national governments need addresses to help individuals secure a legal identity, to facilitate the planning and implementation of public policies and services (like water and electricity), to respond effectively to natural disasters and diseases by providing aid and emergency services, to reinforce national and international security, and to facilitate tax collection. Businesses also need accurate addressing networks to locate clients and providers, promote and facilitate access to products and services, deliver goods, send mail and develop new markets.

UPU monument, Berne, Switzerland

A public good

The absence of a complete, correct and unique national address infrastructure constitutes a major socio-economic challenge for a number of developing countries. A quality address infrastructure must be considered as an essential part of a country's socio-economic infrastructure, not only improving public services, but also facilitating business, trade and, consequently, national development. In view of the vast benefits it provides, address infrastructure can be considered as a public good, alongside traffic lights and national security. Moreover, the benefits extend beyond a country's borders, contributing to the global well-being. Where addresses do not exist, therefore, governments should make every effort to work with national, regional and international stakeholders to expand the address network.

A global initiative

In June 2009, the UPU launched an initiative to meet the global challenge of providing everyone with an address. The initiative, "Addressing the world – An address for everyone", aims to create synergies between United Nations organizations, intergovernmental institutions and other interested parties to emphasize the value of addresses, identify problems related to not having an address and, above all, tackle the challenges associated with the lack of addresses. The final goal – to ensure that every inhabitant has an address – is certainly ambitious, but the UPU is ready to facilitate the necessary collaboration among stakeholders at the national, regional and international levels to help countries implement national addressing projects and work together to find solutions, fund projects and expand knowledge. In order to put addressing on the global development agenda, I presented the initiative to the United Nations System Chief Executives Board in October 2009. The body endorsed the initiative, with the particular support of UN Secretary-General Ban Ki-moon.

There is no doubt that the initiative's success depends on the combined efforts of all our partners. We need commitment at the national level, synergies at the international level and private-sector support. Given the potential of addresses to improve people's lives, I am convinced of the importance of raising governments' awareness of this global issue.

This white paper is the result of recent efforts undertaken worldwide in the area of addressing, involving partnerships at all levels. Through case studies, this publication shows the significant role that addresses play in many aspects of society and the economy. It also provides valuable insights from major organizations on the ways that addressing acts as a driver of development.

I sincerely hope that this white paper will convince political leaders of the importance of addresses and encourage them to put in place addressing policies that strengthen their national infrastructure. I am asking all governments to commit to implementing national addressing policies by endorsing the solemn declaration that accompanies this paper. It is only through the commitment of nations and assistance from international and regional donors that we can achieve the goal of an address for everyone.

Edouard Dayan,
Director General, International Bureau,
Universal Postal Union (UPU)

Port Villa, Vanuatu

Executive summary

Address infrastructure is an essential public good. Addresses facilitate the provision of public and private services, improving the response of aid and emergency services in tackling disease and natural disasters for example, while fostering social and economic development in general. Benefits extend across borders, contributing to the global well-being. As such, address infrastructure can serve as a basic foundation for the attainment of the United Nations Millennium Development Goals and other global aims.

When included as part of a nation's infrastructure, an address helps to provide social and legal identity. In its report *Making the Law Work for Everyone*, the Commission on the Legal Empowerment of the Poor identified that four billion people are excluded from the rule of law. The report claims that a large majority of these people cannot enjoy their full rights as citizens because they often lack an identity. As a person's identity is often tied to having an address, various UN organizations and other international organizations support initiatives to strengthen national address infrastructures.

Since 1999, the Universal Postal Union has assisted national authorities in assessing their addressing needs, including the design of specifications and address dissemination methodologies, to enable interoperability at the international level. In 2009, the UPU launched an ambitious initiative, "Addressing the world – An address for everyone". This initiative received the full support of the United Nations System Chief Executives Board, chaired by UN Secretary-General Ban Ki-moon. The aim is to create synergies between international stakeholders and tackle a myriad of addressing challenges. To ensure the success of this initiative, there is a need for commitment at the national level, synergies between countries and organizations at the international level, and public and private sector support.

This white paper aims to enlighten political leaders on the importance of address networks. It is accompanied by a solemn declaration that serves as a call to governments to endorse and commit to the implementation of policies that strengthen national address infrastructure. Prepared in cooperation with several UN organizations and other partners, and featuring an innovative analysis of theory and practical perspectives, this paper supports the need for a better understanding of the role of address infrastructure in social and economic development. It aims to help governments conceptualize the addressing problem so that the goal of an address for everyone can be achieved.

Address infrastructure as a global public good

Societies are formed to ensure their common welfare, and the basis of this welfare is the provision of certain essential elements, or public goods. Two key characteristics distinguish public goods from private goods: their non-rival and non-excludable properties. Once provided, goods with non-rival and non-excludable properties allow individuals to utilize the goods

in question without reducing their availability for others and without impeding their use by others.

Since the link between types of usage, benefits and supply cannot be clearly identified, public goods have unclear property rights, which represents a fundamental difference between them and private goods. As a result, the free market cannot ensure the efficient supply of public goods, such as national peace and security. For example, a national security system is a "pure public good" as it protects all inhabitants of a nation, without exclusion, and cannot be exhausted by the addition of new inhabitants. Such is the case with address infrastructure.

With the advent of globalization, public goods have increasingly acquired cross-border significance. These global goods are determined through international cooperation, consensus and convention, such as the Millennium Development Goals – for which address infrastructure constitutes a significant enabler.

There is no doubt that addressing – the network of road names and house numbers – constitutes a key element of functioning societies. While a single address in itself does not constitute a public good, the national address infrastructure, of which it forms a part, is an essential public good, and through interoperability with international systems the totality of addressing networks can be determined as global public good. Address infrastructure provides access to the rights and duties of citizens from the local to the international level, as well as providing businesses with access to markets. All echelons of society should thus have equal access to address infrastructure in order to capture the social and economic benefits at the local, national and international levels.

The practical benefits of addresses

Addressing policies at the national level are often pushed aside in favour of more immediate policy needs. However, by providing a fundamental knowledge base to inform decision making and action, addresses help to develop, implement and support other critical national policies.

Governance

Identifying citizens, reinforcing the rule of law, expanding electoral participation and implementing e-government are features of good governance, all of which are supported by an address infrastructure. Without an address, it is harder for individuals to register as legal residents. They are excluded from access to public services and institutions, and denied the rights of citizenship. This includes access to democracy. Addresses allow individuals to register to vote and permit governments to map voter districts and populations, aiding appropriate policy development and transparency.

Urban development and management

Over the last few decades, developing countries have witnessed an explosion in rural to urban migration, posing a myriad of problems for governments. The result has been the growth of informal settlements, which, according to some estimates, comprise a third of urban populations in developing countries. These areas house the urban poor, who are excluded from basic services like water and sanitation, and subject to weak infrastructure. Addresses help to map areas that are often overlooked, while providing a platform for vital census data gathering and infrastructure planning.

Migration and social integration

In areas that suffer from isolation and exclusion, an address promotes peace and social cohesion by fostering exchange between communities and the government. Furthermore, the identification of culturally important areas can generate community awareness of shared culture, thereby ensuring their preservation. More fundamentally, living in an area without an address prejudices the procurement of formal employment or quality education. In countries that lack address infrastructure, many businesses are unable to register themselves because they lack mandatory information, such as an address. As a result, they are forced to remain informal and are barred from accessing finance, banking, other supports and payment of duties.

Karial slum, Dhaka, Bangladesh

Security

Unidentified and inaccessible areas within the national territory provide a breeding ground for crime, insecurity and violence, which contribute to the internationalization of organized crime, affect both the national and global welfare. Spatial organization data, including addresses, provides governments with the ability to identify, locate and access marginalized areas in order to incorporate them into the nation.

Economy and commerce

When linked to governance, law, social policies and planning, addresses help to ensure protection of investments for individuals and the private sector. By creating a reliable environment for public and private sector transactions, a secure address infrastructure benefits the economy and commerce, by improving the transfer of goods and services from producers to consumers, nationally and internationally. This is especially true for postal businesses, which benefit immensely from the development of delivery points, increasing their ability to reach more customers and provide truly universal service.

Information and technology

The right of all people to access ICTs is a Millennium Development Goal. However, barriers to the access and expansion of networks remain. In this respect, addresses continue to serve an important role as a universal means of communication between individuals and governments. Address infrastructure supports ICT in three ways: (1) as an infrastructure upon which to build other systems; (2) as a complementary information system; and (3) as an alternative to hi-tech systems, which may be unevenly distributed.

Environmental sustainability and risk and disaster management

As cities grow, efforts must be taken to make them environmentally sustainable and resilient to disasters. Cities that grow beyond their set boundaries often infringe on fragile ecosystems, increasing their vulnerability to disease and natural disasters. Address infrastructure can support the mapping and appraisal of risk areas and national resources, by identifying and confirming the location of vulnerable areas and populations. Additionally, correct addressing provides for a system of clear routes, labelled streets and identifiable houses, which facilitate the creation of practical strategies for delivering goods and services when natural disasters or disease outbreaks strike.

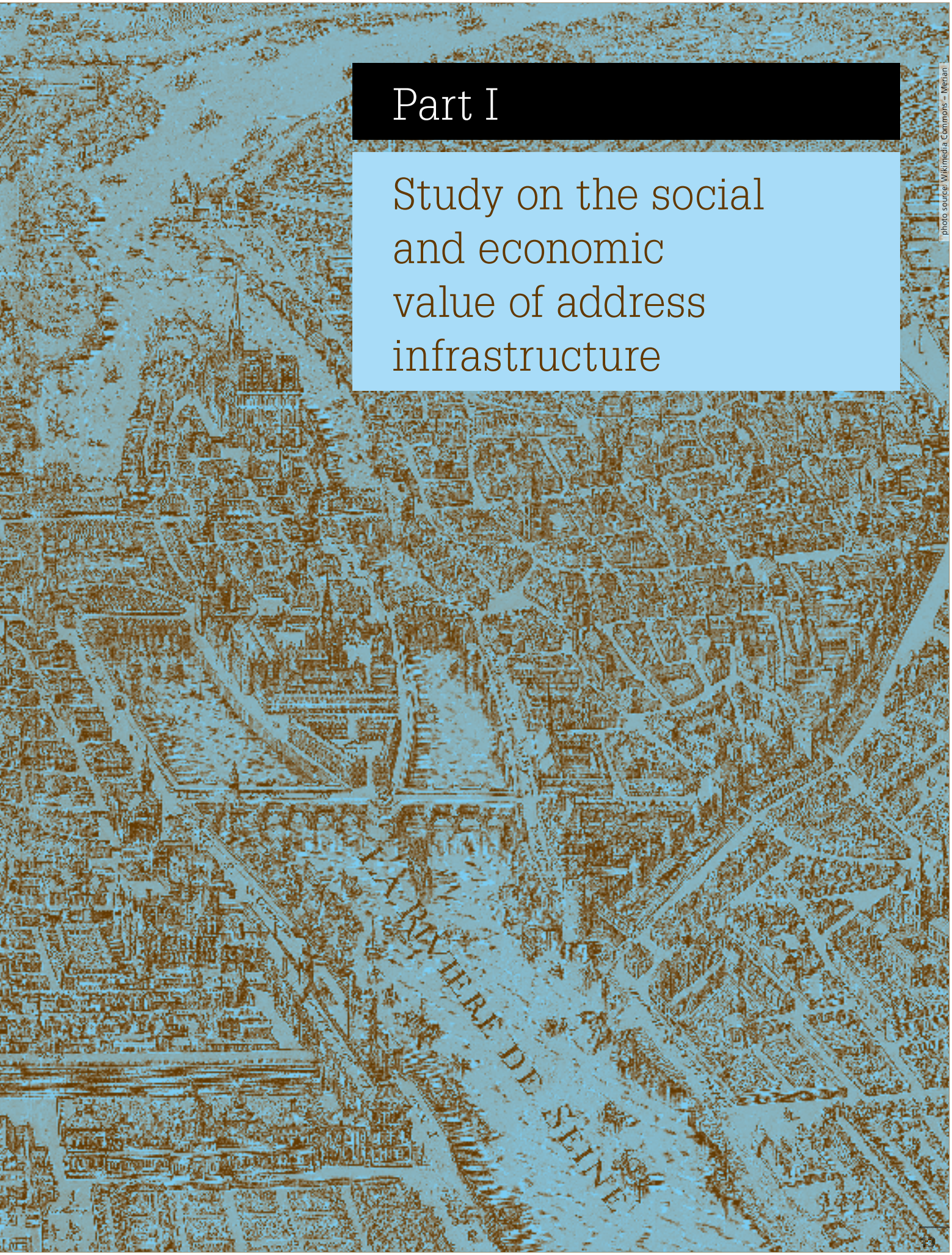
Partners in the initiative

Eight international organizations (African Union (AU), EURopean ADdress INfrastructure (EURADIN), International Organization for Standardization (ISO), International Telecommunication Union (ITU), United Nations Development Programme (UNDP), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Settlements Programme (UN-HABITAT) and the World Bank (WB)) and five countries (Costa Rica, Denmark, India, Korea (Rep.) and Tanzania) have contributed to this white paper by providing insights into the individual challenges and opportunities they face in the fulfilment of their activities with or without sound addressing systems.

Conclusion

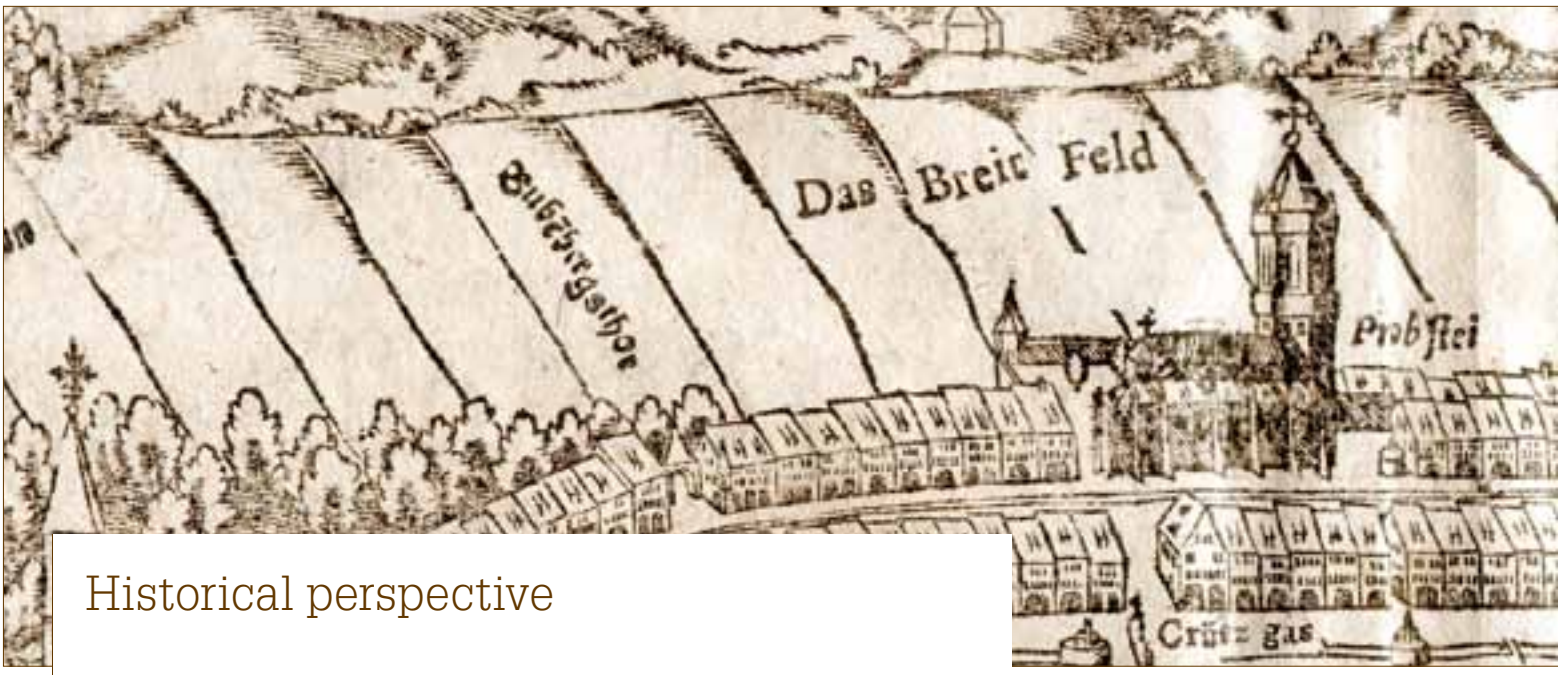
Individuals, governments and businesses are all stakeholders of address infrastructure. Investing in address infrastructure is a fundamental step in connecting people to public and private services, and human rights. But beyond the individual significance, address infrastructure enables the good of the nation and the global population by setting the foundation on which critical national policies can be built. However, building this infrastructure requires a common awareness and action plan that is supported at the local, national and international levels. Political willpower is the key to guaranteeing that an address infrastructure is developed for the benefit of all.

Map of Paris, France (1645)



Part I

Study on the social and economic value of address infrastructure



Historical perspective

Descriptions that provide the means to locate and reach destinations have always existed in one form or another. Since antiquity, descriptive addresses have helped people to orient themselves through references to major roads, landmarks, marketplaces and religious buildings, among others. The expansion and growing complexity of societies, however, created a growing need for clearer identifiers of place. The need for better territorial knowledge and the ability to precisely locate destinations resulted in the growing adoption of street naming and house numbering. The origins and development of these practices can provide a valuable insight into the need for address infrastructure today.

The emergence of road infrastructure facilitated the organization of territory into governable entities and promoted communication and exchange. Road infrastructure played an essential role in connecting cities, and enabled the fulfilment of a variety of functions, ranging from better management of empires to improved methods of accessing populations. Roads and road infrastructure evolved throughout epochs and cultures, and became increasingly complex. This complexity required the specific classification of roads into a hierarchy, based on size and function. One of the earliest examples of this systematic classification of streets into types, and subsequent need to provide street names for differentiation, occurred in the eighteenth century in Western Europe.

The simple identification and organization of a few principal streets in the colonial cities of ancient Greece developed throughout the Middle Ages and evolved into today's underlying address infrastructure. This infrastructure is composed of a network of many unique physical addresses, each comprising a house number and street name that can be precisely identified and located. But although the seeds of street naming are rooted in ancient societies, at the time there existed no systematic way of identifying specific locations. Thus, these societies cannot be considered as originators of address infrastructure, but rather a first step towards building its foundations.

Europe and the United States during the eighteenth century were the first to provide a systematic way to structure address networks, building on past methods of road identification. Consistent street name identification throughout cities improved spatial organization and contributed to a better basis for establishing practical governing strategies, such as the collection of taxes. Over the years, the applications of address networks continued to expand, stretching beyond the mere facilitation of communication and organization to provide the basis for social and economic development, especially in the face of new challenges to governance, such as rapidly expanding urban centres.

From antiquity to the Middle Ages

From the time of the ancient Greeks, a combination of historical events and landmarks were used to describe locations (Mumford, 1987). References from 645 B.C.E. show that new Greek colonial settlements were organized by streets laid along a gridiron pattern, which contained important public buildings where wealthy citizens lived and did business (Gutkind, 1972). The Etruscans and the Romans also used this type of regular street plan as part of an early form of city planning. This street plan set the basis for a hierarchy of areas that could be divided by their function and importance to administer the territory (Nicholas, 1997).

The emergence of road infrastructure also served to connect and consolidate larger territories, making road identifiers, such as names, an important means of establishing a communication network that linked remote destinations throughout empires. The Persian Royal Road, for example, was built to unite the Persian Empire and to establish communication and exchange across its 23 provinces (satrapies) (Global Security.org, 2011).

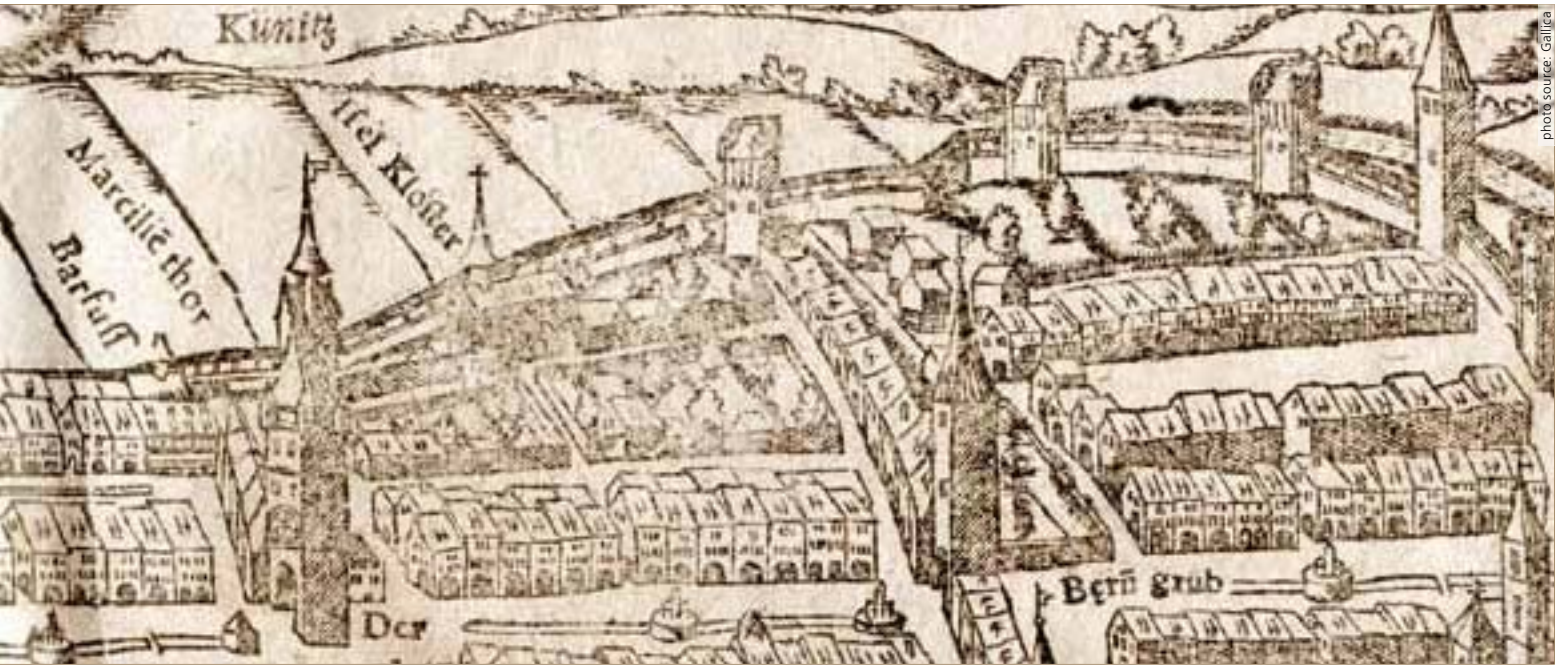


photo source: Gallica

Berne, Switzerland

Road names emerged as a practical tool for identifying main transport ways, and became the symbols of unity throughout empires. For example, road names contributed to the spatial organization of the Roman Empire and reinforced Roman rule. New Roman roads with Roman names and characteristics replaced those of other civilizations, and led directly to Rome (Witcher, 1998). Associating road names with Roman culture was meant to generate a sense of affiliation with the Empire. Great highways, such as the Via Triana, which crossed the eastern part of the Roman Empire, played a critical role in the colonization of the Balkan lands (Gutkind, 1972). Moreover, Romans also used the main streets within their cities to divide urban areas into quarters, in order to organize their citizenry, facilitate the defence of their cities, levy taxes and enable commercial transactions. These streets not only divided the city, but in major urban centres were paved and constituted a public good, provided by the Empire (Ibid.).

The Etruscans and the Romans both designed city plans with two streets intersecting at a centrally located forum, one going east to west and one north to south. This division separated the city into quarters on which administrative districts were formally assigned. Roman administrative districts were further divided into neighbourhood associations based on streets. Streets were named after important families, buildings or after their functions, and were the site of family feuds (Nicholas, 1990).

Despite the early use of road naming to identify important thoroughfares, these examples from antiquity did not constitute address networks. Although a few principal streets and houses were named, no methodological system existed for naming at the city or nationwide level. For the most part, streets remained nameless and houses numberless. In fact, the first official denomination of city streets by name did not become commonplace until the eighteenth century in Western Europe, and although some house names were used to locate an exact site, house numbering was only undertaken in the early nineteenth century.

In general, street names developed from informal references to landmarks to formalized names. Naming increasingly followed a pattern that organized urban space into neighbourhoods and later included the designation of house numbers. The changing concept of public space, a shifting perception of what constituted government responsibility, and the expanding needs of the newly formed state required consistency and formalization of street naming and house numbering.

Unlike their Roman predecessors, the European cities of the Middle Ages differed greatly in their use of urban space. The end of the Roman Empire brought population decline and increasing migration from urban to rural areas. This population shift and the break up of the Empire affected the importance of long-distance trade routes. Poor maintenance and administration resulted in the deterioration of roads, which became unreliable and at times dangerous. Trade with the Far East was greatly reduced and in its place local markets and fairs sprang up. The rise of local markets reshaped urban layouts (Nicholas, 1997). Street names in cities at this time were largely unwritten, unofficial, and reflected the functions of different sections of a city, such as a marketplace, or the location of an important building on a street, such as a church. These names helped to locate relatively important public areas within the city and provided better access to markets.

Towards the high Middle Ages, the security offered by city walls once again began to attract populations to cities, where streets were used as an embryonic form of city planning, establishing a more or less fixed city plan that can still be seen today (Westfall, 1974). A prime example is the layout of London, which between 830 and 1000 C.E. experienced a

significant urban migration of people seeking the protection of city walls, and whose settlement mostly fixed the permanent city plan (Nicholas, 1997).

While Europe in the Middle Ages suffered from a decrease in economic activity, the Islamic world experienced a golden age and grew more prosperous. The distinct circumstances that these regions faced shaped the spatial development of their societies and influenced urban policies. Different geography, climate, history, cultural values and economic prosperity were all influential in the development of urban areas. Cities were forced to conform to topographical limitations and to take advantage of available resources, while also observing cultural preferences of religion and space.

In general, Islamic cities were larger and more diverse than their European counterparts and followed a different layout. In contrast to the rectangular plans of European cities established during the Middle Ages, Islamic cities were constructed on a circular design. Concentric circles divided the city into areas by function, with public buildings in the centre and residential areas farther out. Roads were also divided into a hierarchy based on importance. Baghdad, founded in 762, illustrates this typology, with a radial road network categorized by road type (avenue, major streets, smaller streets and alleys), reflecting an early identification of street hierarchy (Nooraddin, 2004). Within each area of the city, the leaders of each subdivision administered important governmental roles. Religious leaders and markets were located in the centre of the city, reflecting the priority of religion and commerce within the city. The elite were also located in well-planned areas close to the city centre, the primary area of activity. The rest of the population was located in residential areas that grew spontaneously on the outskirts. As in Europe, these areas were reserved for poorer sectors of the population, who resided in separate areas that were less central, less planned and largely unidentified (Nicholas, 1997).

In the pre-Columbian Americas the majority of cities did not follow a strict orthogonal pattern, but nevertheless seemed to have a predetermined layout. The majority of Central American and especially Mayan cities concentrated around a central area surrounded by public buildings (Smith, 2008). Most prominently, the city of Teotihuacan had a central avenue, the "Street of the Dead", which branched into other major avenues laid out in relation to the cardinal directions (Hendrick, 1999). This pattern also divided the city into distinct sections similar to Roman quarters and Islamic concentric circle plans. In South America, the Incan town of Ollantaytambo, among others, followed a regular grid pattern with transversal streets that ran parallel to one another (Protzen, 2008). This pattern is seen across cultures, especially during colonization, as a means to organize an otherwise chaotic urban area (Gutkind, 1972).

For the cities of Europe, the tenth century brought population growth, division of land plots, and the naming of streets based on trades practised in them (Nicholas, 1997). Europe's urban population continued to increase rapidly throughout the eleventh and twelfth centuries, leading to the appearance of mass urban housing and the alteration of streets to improve identification and accessibility to the marketplace. The twelfth to thirteenth centuries witnessed a revival in long-distance trade as merchant associations were formed to secure routes. However, the activities of these tradesman and their locations became an issue of strict government control. Many governments established regulatory policies for merchants and the marketplace. Southern France was especially strict in its separation of craftsmen and trades by quarters (Ibid.). Greater regulation and identification of the population contributed to the development of the nascent concept of citizenship as a basis for rights and responsibilities. While communal birth records and "correct" religious affiliation would often grant citizenship, place of residence began to play a larger role in assigning citizenship based on the payment of city taxes tied to property ownership (Ibid.).

Map of London, England (1560)

Map of Baghdad, Iraq (between 767 and 912 AD)

Teotihuacan, Mexico

> By the thirteenth century certain goods began to fall under the jurisdiction of the community, or the city. Goods and services including tax collection and street maintenance passed from the responsibility of private individuals under a feudal system to that of a public entity, usually a city government. As early as 1300, lords in Germany handed over the responsibility of street repair to the city government (Nicholas, 1990).

Governments across Eastern and Western Europe saw the identification and security of property rights as a national priority for securing a tax base (Gutkind, 1972). However, confusion over property rights plagued many cities, including Vyza'ma, Russia – a situation

exacerbated by chaotic streets, intersections and undefined plots. This made it difficult to establish rights and provoked conflicts over land claims, as well as making the organization of public services difficult (Ibid.). Many different initiatives were attempted in response to this challenge, especially for regulating streets. In the 1300s, for example, many houses in Romania were built to line a main road, forming a "street village", which aided in the management of village life. The Turks and Austrians, who colonized villages in Romania, were also known to employ gridiron plans to improve their ability to govern new territories (Ibid.).

Map of Manhattan, New York, USA (1842)

Sixteenth-century Europe was characterized by government initiatives that began to introduce street plans to better administer territory. Although many unsigned and unofficial street names remained as a result of popular usage (Badariotti, 2002), some Middle Age cities, such as Munich, did possess a few official street names, which were mentioned in communal property and tax records. Descriptive addresses including a street name, but not a house number, such as the "corner house on the Sendlinger Gasse" (Friedrichs, 1995), exemplify the type of information recorded in official property registrations.

Other independent and isolated examples of addressing occurred at this time, including an attempt to number the houses built on the Notre Dame bridge in Paris in 1512 (Farvacque-Vitkovic, et al., 2005). Although principal streets or market areas were named in some cities, as shown by a 1551 map of Borgo (a historical district of Rome), the majority of streets were left unidentified, and many places remained nameless. As a result, many sections of the population seemed inconsequential to the consciousness of the city (Westfall, 1974). The development of street names in the Middle Ages focused on government buildings, religious institutions and the elite (Nicholas, 1997). The elite lived mostly on named, principal streets, while the rest of the population was relegated to its own quarters and streets or villages, their identification and administration likely of a lower priority. In this way, physical location preserved the social structure (Sjoberg, 1960).

From the Middle Ages to the modern era

The Middle Ages left behind no great developments in street naming; however, the decisions made as early as the thirteenth century in relation to urban planning and spatial distribution largely influenced the subsequent development of modern European cities, including the structure of land possession and population distribution (Nicholas, 1997). The transition from the high Middle Ages to the Renaissance brought changes in the perception of the value of streets to city planning. The emergence of the baroque city between 1600 and 1750 prioritized urban space. Streets that once sprawled haphazardly throughout cities were considered inferior to the systematic street system that facilitated social organization, and long avenues, radial street networks and public places, seen in cities such as Versailles, Paris and Washington D.C. (Gutkind, 1972). As part of this change, the seventeenth and eighteenth centuries saw a re-conceptualization of public space, as new ideas about the modern state and public administration altered perceptions of the role of government (Rutgers, 2000). Street naming in Europe was widespread during this period and names were often assigned by royal decree, frequently after members of royal families as a means of reinforcing legitimacy and national pride (Badariotti, 2002). Many street names evolved to include other names, such as those of important buildings, houses or homeowners.

Governments considered the systematization of street naming a means of granting streets official character and securing government administration of territory. Governing strategies included more extensive regulation of social behaviour, such as prohibiting public drunkenness and implementing transportation restrictions. Ample police presence was required to monitor compliance with these regulations and street naming became a means of aiding enforcement efforts (Pred, 1990). The numbered grid pattern, implemented in Mannheim in 1606 by Frederic IV, was one of many government efforts to structure and fortify towns (Badariotti, 2002). Other cities followed suit. In France, lack of government regulation on the naming of city streets did not prevent members of the fire brigade and the police from naming each street distinctly to enable them to more efficiently undertake their tasks (Badariotti, 2002). In Moscow, new weapons and defence strategies gave rise to the systematized concentric network of roads that still exists today (Gutkind, 1972).

> In Paris, the first streets were named on the initiative of the Lieutenant General of the Police, Rene Herault, who ordered that signs be placed at the corner of each street in 1728.

In addition to growing perceptions of the need to ensure public security from crime and fire, the late 1700s brought a heightened focus on measures against internal revolt. In Russia, Catherine the Great (1762–1796) expanded the Empire's territory and rebuilt newly colonized cities along a systematic orthogonal pattern, as a means of ensuring the security of newly obtained territories. Street naming was also a tool for collecting public information. In France, the collection of statistics and demographic information linked to the individual's place of residence bolstered information about population distribution. This project was spearheaded by a Frenchman, Guillaute, who in 1749 proposed numbering houses to support the enforcement and expansion of fiscal administration (Vincent, 2000). Official house numbering would develop later, but the tendency to name streets for security and fiscal reasons was already prevalent in Europe. In 1763, in Stockholm, a royal decree ordered that the city's main streets be officially designated by street signs (Pred, 1990). Two years later an English bill proposed that the signing of streets and the numbering of houses be delegated to local councils (Miles, 1973).

The numbering of houses progressed in the cities of Berlin (1797), Vienna (1803) and Paris (1806), as an important next step in street

identification (Azaryahu, 1996). The motivation behind many of these naming and numbering initiatives was to clearly identify populations in order to provide a better response to the possibility of revolt or chaos – a fear encouraged by the pervasive discontent prior to and during the times of the American and French revolutions (Pred, 1990). Street naming was seen as a means to link identification information with the location of specific citizens, thereby improving the ability of security forces to respond to rebellion and public disturbances.

Beyond serving as a security tool, street naming played a role in the creation of the city's social consciousness, as well as becoming an important symbol of a government's legitimacy. Prior to the French Revolution, for example, streets were named in honour of the royal family, whereas names on post-revolution signage evoked revolutionary values (Badariotti, 2002). Municipal councils were charged with the responsibility for naming streets and were instructed to incorporate community culture into the naming process. During Napoleon's empire, street names were replaced once again, this time with classical names that harkened back to Roman times in an attempt to create a symbolic connection with the greatness and legitimacy of the Roman Empire. This approach to formalizing street naming formed an important part of government policy for nation building and citizen integration.

In the late nineteenth century, the need for street naming and house numbering expanded across government sectors. Beginning in 1804, the Parisian police announced a goal of creating a population census of citizens and proofs of identity. These proofs helped to usher in a change in the perception of unique identity as identity was expanded to include first and last names, profession and place of residence. Addresses gradually gained ground as an asset beyond the realm of national identity, forming part of an individual's identity. Addresses were increasingly linked to emerging government policies on property ownership, citizen registration, health status, commercial exchange and urban improvement. For instance, in North America, the newly independent cities of the United States were planned along a numbered grid, which facilitated the acquisition and regulation of property (Feirstein, 2001).

> The Netherlands experienced a growth in neighbourhoods during the mid-nineteenth century. As a result, local governments sought to implement "information systems" based on community registrations. Registers were expected to include names and residences, thereby making street names increasingly useful. The number of foreigners and visitors in Dutch cities also increased, creating a larger demand for street names that followed a logical structure (Kooloos, 2010).

In 1807, Manhattan's roads, initially informally named, were formalized into streets, avenues and squares. These paved the way for the city's future growth, and the reorganization was deemed an activity of "local and national importance" (Ibid.). This planning activity soon became a matter of national and even international interest as other cities followed New York's example. This style of street layout became popular worldwide, and the new city plan of Sofia, Bulgaria, evoked "American fashion" streets, referring to the rectangular street network used in American town planning (Gutkind, 1972). The grid pattern was seen as having a primarily commercial motivation, especially in American cities such as New York and Boston, as it facilitated the subdivision and sale of land.

Establishing public order across policy dimensions also became important for cities such as Paris, London and Berlin, which used the planning and naming of streets to oversee population mobility and the movement of goods, and to monitor the hygiene and beautification of cities (Pred, 1990). In 1878, Stockholm authorities implemented a register system, which recorded essential identification information, such as name, address and health status, in order to manage the growing population (Ibid.). This information was then shared across public sectors, including identity and fiscal registers and police enforcement, as a response to the massive changes occurring in urban life.

Beyond these rudimentary forms of city planning, within the context of rapid urban development, Europe experienced the development of increasingly complex address networks. In 1885, Stockholm's street names were revised in response to a chaotic event that left 19 dead and 100 injured in the city centre. It was realized that new practical measures were essential to organize the population, especially the working classes, in order to preserve the city's stability and security (Ibid.). Denmark's streets also underwent a progressive framework for identifying areas. Between 1850 and 1900, the government implemented an address network based upon the systematic numbering of buildings and properties along every road. The system was established first in Copenhagen then rolled out to other major cities (Lind, 2008). At around the same time

Map of Utrecht, Netherlands (1649)

in the Netherlands, informally named streets, previously designated by street builders, were renamed using a methodological approach (Kooloos, 2010).

> In the 1830s, J.G. Kohl, a German traveller, remarked on the layout of St. Petersburg's three principal streets: the Neva Perspective, the Peas Street and the Resurrection Perspective. "It is said that these principal streets meet at the foot of Admiralty Tower, [and] a man, taking his position at this central point, may look down them, and with the aid of a good telescope, see what is going on in the most remote quarters of the city." This layout helped provide government oversight of the growing city. (Gutkind, 1972: 394).

The fifteenth to twentieth centuries saw European urban organization reproduced worldwide as the concepts of population management and security enforcement reached colonial cities. Rectangular street plans, in particular, were employed in new colonies

in Africa and Latin America (Gutkind, 1972). These plans were easily replicated and helped to ensure the accessibility and administration of the newly conquered cities or countries, in addition to facilitating commerce and trade. In the case of Spanish colonial cities in the Americas, rules codified in the 1573 Law of the Indies specified and standardized the construction of a grid pattern with a central plaza. Viceroys were instructed to adhere to city plans that mapped out city centres, housing and trade areas. In Africa, old colonial centres patterned after European cities still remain as part of present day urban layouts, in many cases including some form of addressing (Farvacque-Vitkovic, et al., 2005). Notably, in the case of French occupation, the roads and squares of many colonial cities were widened to facilitate troop movements, similar to the approach used to restructure Parisian streets. Frederick the Great employed a similar tactic of using standardized grid patterns when colonizing the newly acquired eastern parts of Prussia (Gutkind, 1972). Such patterns, however, often changed post-independence or as a result of rapid expansion beyond the original fixed urban space.

In 1830, Algiers became a colony of France and its city structure vastly changed. The pre-colonial Casbah, the traditional commercial centre, became an urban centre influenced by French architecture and organization. The closed residential quarters of the city, the dead-end streets, and the small alleys were all altered into a system of secondary streets, which allowed for better access to the Casbah. A web of streets and squares connected new developments with the old city as a security measure to ensure access to all parts of the urban area (Osmani and Osmani, 2004).

Towards the late nineteenth century, many countries in Europe and the Americas underwent a period of nation building. Street naming was an integral part of this process, and street names became a form of cultural production and much more than a way to identify a citizen's residence or personal identity. The highlighting of certain historical or cultural events helped to shape greater awareness and collective identity. Names became a means to create a national consciousness, unifying citizens and creating stability within diverse segments of the nation (Azaryahu, 1996).

In the twentieth century, some states unified around a common identity, while many others in the developing world experienced the transformation of their cities. Changes in population distribution and greater interconnectedness with other nations were major factors. In 1914, in Baghdad, for example, a new system saw streets expanded to cut through the middle of the city. The large roads became important transversals, which encouraged the naming of main throughways (Nooraddin, 2004). Later, in 1965, the city was modernized and transformed through the participation of famous architects, such as Le Corbusier, Wright, Sert, Gropius, Aalto and Gio Ponti, and the creation of a number of large streets used to connect and develop trade and improve the city's development potential.

Map of Quito, Ecuador (1786)

Map of Annaba (Bône), Algeria (1900s)

Conclusion

Present day addresses play an underlying role as infrastructure in most developed societies. Despite this important role, the history of address creation is mostly taken for granted, as many citizens in western countries have an address and use it unconsciously in everyday life. What is often overlooked is that the need for street naming and house numbering is the result of an evolving historical process, responding to the needs of different societies at different times. The progress and development of security, access to property, commerce, organization and administration, culture, and health have all benefited from an improved spatial organization. The identification and recognition of certain areas through the naming of streets has created new opportunities for public administration and served as a basis for development. Although much of the history of addresses is taken from a European perspective, other forms of identification and strategies for administration can be seen worldwide.

The following section on regional trends surveys the current state of address development and implementation in different regions. Address development worldwide has been diverse and has taken different forms. In many nations, parallels can be drawn between the historical development of addresses and the current challenges of urbanization, security, identity and nation building.

Regional trends

Expo 2010 Shanghai, China

Different environments, governance systems and historical circumstances around the world have shaped the development and intricacy of address networks. These networks have emerged in a variety of ways in different territories, with no uniform development in the majority of cases, although similarities can be seen within regions. By considering the development of addressing through regional trends, it is possible to provide an overview of the status of the addressing scene throughout the world.

Western Europe

Street names and house numbers became commonplace in major cities in the nineteenth century; however, rural addresses only became the norm in the second part of the twentieth century. Most countries have completed the naming and numbering of streets and houses and have charged specific agencies with collecting and maintaining address information, which is often stored in databases. In 2007, the European Union (EU) adopted a directive to establish an Infrastructure for Spatial Information in the European Community (INSPIRE). Through this, the EU seeks to improve address information interoperability and databases via the inclusion of road names, house numbers and postal codes as spatial data.

Eastern Europe

Towns and cities developed as a function of their relationship with different empires. Urban plans characterized by winding and discreet streets were transformed into rigid layouts, intended to maximize security and vigilance and improve communication and transportation routes. The Soviet central planning had a great influence in the mid-twentieth century. From the post-communist era, sound address and postcode systems have developed, characterized by a high percentage of standardized addressing across countries and by the existence and use of postcodes nationwide. For nations seeking entry to the EU, certain conditions such as the requirement to have a nationwide address infrastructure remain a prerequisite.

Russia

In the eighteenth and nineteenth centuries, the Russian Empire charged its urban planners with transforming cities by regularizing urban space into a radial street system, converging to a single point. In the mid-twentieth century, this system was superseded by the rigid designs of Soviet central planning, which emphasized a methodical organization of public space, orderly streets and large buildings. Today, Russia is experiencing a radical change in urban layout with transportation planning and GIS technologies playing an increasingly important role. Despite these developments, obstacles to the use of GIS remain, on account of a lack of standardized databases and of a complete spatial data infrastructure.

North America

The creation of addresses was a key stage in the early development of North American nations, playing an essential role in the regulation of territory, nation building and securing of property rights. In the United States, streets today are mostly defined along an alpha-numeric grid and are either named or numbered. Addressing policies are determined by individual states, each of which is responsible for developing addressing standards. In Canada, the provinces also have their own addressing policies. However, coordination at the national level was formalized in the 1950s and 1960s with a view to reinforcing national boundaries. The Canadian address system uses a numbered pattern to identify streets.

Central America

While the Spanish colonial planning model initially influenced the layout of Central American cities, many streets do not currently follow a systematic pattern, and many remain unnamed. In recent years, the proximity to the United States and the use of GIS have resulted in

addressing methodologies that combine the colonial model (street naming) and the alpha-numeric grid (street numbering).

Caribbean

Formal and informal attempts to map Caribbean cities have been undertaken, but no official regulation exists as of yet. Addresses in this region are often incomplete or not standardized. Although few addressing policies have emerged, the demands of tourism and business are now a driving factor in their development. Typically, street names exist primarily in parts of main cities. House names and plot numbers are the norm, and house numbers are not commonly used. Notable exceptions include Cuba, Guyana, Suriname, and Trinidad and Tobago.

South America

In South America, addressing policies are modelled on a gridiron street pattern, centred on a square or a church, generally following colonial Portuguese and Spanish models. Overall, major cities have sound addressing policies that identify the majority of streets and house numbers. However, in rural areas and informal settlements addressing becomes scattered. In recent decades, addressing has been implemented in many countries, with the support of geo-location technology, as a means of improving public administration, communication and business.

Middle East

Systematic mapping is not traditional in the Middle East, and main city streets were originally narrow and curved. The climate and religious values of Islam promoted a layout and street pattern that still prevail, dividing the urban area into the inner city, the shahristan or madina, the suburbs, the rabads, and the bazaars. Modern times have seen the development of addressing policies to open up cities and absorb the growing population.

In the Arab Gulf, addresses are mostly identified by blocks of buildings, while the thoroughfare is considered of secondary importance. In recent years, address systems that replace traditional thoroughfares with GIS-housed coordinates have been developed to provide a location address.

Africa

Under the influence of colonial models, addresses were allocated in city centres, while street numbers alone were used in many suburbs, and fewer, if any, address networks existed in rural areas. After independence, this colonial system fell into disuse, and it was not until the 1980s that addressing policies began to develop progressively based on systems that identify throughways and house numbers. While Africa's rural areas have traditionally faced political and physical isolation, they are now becoming increasingly integrated into national addressing plans that aim to improve communication and services, and enhance national integration. Overall, a new wave of consciousness about the importance of addresses is sweeping African nations. Infrastructure improvement, including address infrastructure, has become a priority in most African countries, and for the African Union Commission, which is supporting the creation of guidelines for its members with reference to harmonizing addressing policies.

Australia, New Zealand

Both Australia and New Zealand have developed addressing policies along a well-organized urban plan, and there is coherency between addressing policies at the state and national levels. Addresses have existed in New Zealand's urban areas since at least the 1870s, when mail began to be delivered to homes, requiring local authorities to introduce more regular street numbering.[1] However, addresses in rural areas developed later in both Australia and New Zealand in the late 1980s and early 1990s. Currently, both nations are seeking to use location identifiers (such as a physical address) to support new technologies, including spatial data infrastructure (SDI).[2]

Oceania

There has been little address development in Oceania and there is a lack of a concrete policy. It is not certain whether this absence of addresses stems from a lack of interest or the small and scattered population of these areas.

East Asia

This region is characterized by address systems that have developed in isolation from the influences of other countries or colonial powers. Typically, address systems in this region refer to administrative areas rather than individual buildings, comprising three main elements: the administrative district, the geographical area name and numbers (parcel/plot number). Over time, the division and consolidation of parcels has resulted in systems that can at times be inconsistent and illogical. Efforts have been made, especially in dense urban areas and large-scale developments, to change or rationalize this system to one based on building numbers.

The Chinese address system follows its own logical scheme and incorporates specific cultural values, natural elements and cardinal directions. Within cities, streets are divided into sections pertaining to the cardinal direction. Long streets can be divided into three parts referring to the eastern, central and western part of the street, and can even change names within a large city.

Southeast Asia

European colonialism has influenced the character of address systems in the region. After independence, countries developed their own systems based on previous colonial trends, while preserving their own national and cultural characteristics. Today, addressing policies vary between countries, but they are in constant development, following a standardized process towards a complete policy with identifiable elements.

1) New Zealand Post Office website: http://www.nzpost.co.nz/

2) Pers. Comm., Richard Murcott 27 July 2011, e-mail.

Address infrastructure as a global public good

Individuals form societies to ensure their common welfare. The basis of this welfare is the provision of certain essential elements that can be called public goods. **Public goods** have two underlying properties: they are non-rival and non-excludable. Non-rival goods can be used by some individuals without impeding their use by others. Non-excludable goods are accessible without reference to gender, status or age. Goods with these properties provide societies with a foundation of stability and security, which contributes to the prosperity and productivity of their citizens. Public goods can be abstract in character (e.g. national defence, law enforcement) or practical and concrete (e.g. streetlights, lighthouses).

State involvement in the supply of these types of goods has grown throughout history. The number of goods and services defined as public goods has progressively increased and has further evolved in recent decades in response to the intensification of interconnectedness among nations. Public goods that were once the responsibility of a single nation are now recognized as having cross-border impacts. Global public goods encompass the basic properties of public goods while extending across countries, populations and generations (Kaul, Grungberg and Stern, 1999).

The goal here is to evaluate whether **address infrastructure** [1] can be conceptualized as a global public good. This analysis considers the properties and benefits of a global public good to ascertain whether these are present in address infrastructure. Above all, the analysis aims to highlight the important role played by address infrastructure in locating and accessing individuals and places, and its significant impacts on diverse policy sectors across borders in the context of development. This analysis is preceded by an explanatory discussion of public goods and global public goods, their properties and their benefits.

Public goods

Traditionally, public goods are defined by their non-rival and non-excludable properties, which describe the ways in which a good can be consumed (Cowen, 2008). **Non-rival** means that consumption by one individual does not affect consumption by another (e.g. one individual may enjoy sunlight without reducing its availability for others). **Non-excludable** implies a lack of barriers so that a good may be accessed and used by all (e.g. a lighthouse cannot exclude individuals from using its light). It is impossible, or at least prohibitively difficult, to prevent individuals from using non-excludable goods.

These properties obscure the linkages between use, benefit and supply, and as a result, public goods have unclear property rights. This makes it difficult to assign ownership or enforce a user fee. These unclear property rights underpin a fundamental difference between public goods and private goods and explain why investors are often unwilling to invest in public goods. Once implemented, goods like national security systems can be used by all regardless of their willingness to pay, thus creating a disincentive for market actors.[2] This reluctance to invest means that the market cannot ensure the efficient supply of public goods. Consequently, public goods tend to suffer from **underprovision**.

This underprovision is exacerbated by the presence of **externalities**. This means that the costs and benefits of a good cannot be limited to the investor. Externalities are either positive or negative depending on whether a third person, uninvolved in the transaction, benefits or faces a cost. Someone who invests in a good with positive externalities pays most or all of the costs even if the benefits are shared. In the case of a communications network, the network may have been created for a specific application but as network coverage expands, the number of users increases, raising the potential for greater linkages, transactions and applications, thereby making the network more valuable. On the contrary, someone who invests in goods with negative externalities

Singapore, Singapore

receives the benefit without paying all the costs. In the case of fossil fuel use, a company burning fossil fuel for its energy needs creates air pollution, which has a negative effect on people's health. The cost of using fossil fuel may not be captured in the price of using the fuel itself, suggesting that the producer does not bear all the costs of its investment.

In addition, public goods can also be considered as pure or impure, depending on the extent to which they have non-rival and non-excludable properties.

Pure public goods are absolutely non-rival and non-excludable. For example, a national security system protects all inhabitants of a nation without exclusion. Moreover, that protection cannot be exhausted by the addition of new people to the nation. These types of goods are extremely beneficial for societal welfare, but are few in number as a result of their absolute non-rivalry and non-excludability.

Impure public goods may have rival or excludable properties that influence their ability to become private goods. It is often a matter of government choice to determine what goods should be placed in the public domain. To offset the underprovision of public goods, the government is obliged to intervene to ensure the public nature of a good and to guarantee the potential for societal benefit. To do so, the government often uses funds obtained by taxes in order to invest in goods that expand benefits and produce conditions for secure development and stability.

For example, in the case of a television signal, the signal is non-rival but excludable. The signal is not inherently excludable, but can be made so in order to charge for its use (Kaul, 2001). The signal may also be made non-excludable if the government were to require that some channels be kept for free public television. In these kinds of cases, the good is an impure public good because the possibility exists for it to be made private and excludable. Such a decision may be taken to prevent the unequal impacts of the market (e.g. the majority of people cannot afford the signal) or to take advantage of positive externalities (e.g. enhanced communication between the government and citizens). However, before certain goods can be invested in they must be defined as public goods, so as to articulate their vulnerability to market failure and to manage or exploit their externalities.

Society's perception of what should be defined as a public good is in constant evolution. The evolution from an industrial society to a post-industrial modern one has altered notions of the role of government in terms of the provision of certain goods considered as fundamental for societal welfare (Menashy, 2009). Many governments now recognize the need for certain goods to be public, as a response to the many deficits created by industrial society. Moreover, the challenge of underprovision constitutes the chief reason why public goods increasingly fall under the purview of the state (Desai, 2003).

The intensification of globalization has given international scope to formerly national dilemmas. Challenges of the twenty-first century, such as halting the spread of infectious disease and upholding international peacekeeping, require global responses able to elevate the discussion of national public goods to the international level. When the actions of citizens in one country can affect those in another country, the consequences are extensive. This premise vastly influences the discussion on global public goods.

Global public goods

Global public goods share the basic properties of public goods but extend to beneficiaries across countries, populations and generations (Kaul, Grungberg and Stern, 1999). In recent years, discussion of what can be considered a global public good has gained international importance as events within states take on a larger influence and states see themselves affected by external issues. Defining global public goods at the international level is one

means of conceptualizing solutions to worldwide challenges.

Like public goods, global public goods are **non-rival**. Once a global public good is made available, any person in the world can use it without its availability being diminished for anyone else. One example would be the international use of communication networks, such as the Internet. The non-rival character of global public goods is also more extensive than that of public goods in that they incorporate potential for future users. Attention to the next generation of users reinforces the idea of sustainability, namely that a good can be used to meet the needs of the present without compromising its availability for future generations (Brundtland, 1988).

Global public goods also expand on the idea of a good being **non-excludable**. Global public goods have no barriers to access, either nationally or across populations and borders. Goods such as air and the atmosphere are examples of non-excludable global public goods. They have no obstacles or conditions to their use and, therefore, present a large potential for equal access.

As seen above, public goods that have many benefits for all also have poorly defined property rights and crudely defined responsibilities. This discourages investment and contributes to **underprovision**. When the scope and influence of a public good is expanded, more challenges arise in ensuring its provision worldwide, given the weak capacity of the international community to deal with market failure. One such example would be the underprovision of critical goods, such as clean air or vaccines to prevent the spread of disease – both global goods necessary for a safe and stable environment.

At the international level, global public goods can also be categorized as pure and impure. **Pure global public goods** have absolute non-rival and non-excludable properties worldwide. This rigorous definition includes only a few goods, such as sunlight and peace and security. Other goods that lack these absolute properties are **impure global public goods**, such as information or education. These may have private aspects, for example, excludability. In many cases, agreement is reached to make these private aspects public at the global level in order to create overall benefit. Such decisions are based in part on the presence or absence of externalities.

Because externalities can be positive or negative, certain goods are designated global public goods to profit from their potential positive impacts or to respond to potential negative impacts. For example, vaccines that control infectious disease are considered to yield a **positive externality**, as participation in a vaccination campaign not only protects the individual, but also provides greater benefit to society by lowering the amount of vehicles of disease. In another example, greenhouse emissions released by burning fossil fuels in one country produce a **negative externality** that contributes to climate change worldwide.

In order to exploit positive externalities and to monitor negative externalities for societal benefit, impure public goods must be designated as global through international consensus. Such a consensus, however, requires a belief in the potential benefits for universal welfare. Two types of impure public goods that have international support because of their positive benefits are merit goods and human-made goods.

Merit goods are born of the growing public consciousness that everyone should be entitled to certain basic goods. For example, the right to life, the right to food, and the right to water and sanitation are seen as fundamental necessities for human health, empowerment and prosperity. The United Nations Millennium Development Goals (MDGs) are an example of merit goods. Access to basic education is a classic example of a merit good. Investment in universal primary education is expected to raise the education level of a population and produce educated citizens of the world. While merit goods are considered the responsibility of the state, investment in these goods affects the international welfare.

Human-made goods, such as information, physical networks and infrastructure, can also be considered as impure global public goods (Kaul et al, 2003). Unlike merit goods, deemed necessary for human development, human-made goods promote inclusiveness through investment in infrastructure. Once implemented, additional users can use these types of goods without extra cost. When more individuals are granted access to networks and infrastructures, these goods become more valuable, even across borders, by attracting more and diverse users. As a result of this inclusiveness, more people, governments, businesses and even international actors can participate in a greater number of cross-border transactions. Human-made goods do not end at a nation's borders, but can instead contribute to the creation of positive benefits in the international system, such as connection, communication, development and stability.

Although global public goods contribute to overall welfare, it is increasingly recognized that these goods cannot be provided solely at the national level. Their complexity and importance require that they be handled at the international level. A forum that brings the international community together to discuss the benefits and challenges of global public goods may help to form institutions that can catalyze the necessary action for their provision (Task Force, 2006). General international guidelines that support the provision of public goods will contribute to the creation of national strategies that incorporate concepts of public and global public goods into governing models, adapted to local systems and particularities.

In addition to the MDGs, there have been other international activities undertaken to raise awareness of the value of designating certain goods as global public goods. Most notably, the United Nations Development Programme (UNDP), the International Task Force on Global Public Goods (the Task Force), the United Nations Industrial Development Organization (UNIDO) and the World Bank have emphasized the importance of defining global public goods in order to contemplate their provision. These organizations seek international cooperation to provide global goods, with a view to generating knowledge, protecting the environment and improving international financial stability, among other things. The more people or governments that agree that a good is essential, the more support there will be for the establishment of infrastructure that is inclusive and that can be considered as a global public good.

Address infrastructure

Address infrastructure offers a specific example of a communication and physical infrastructure that has the potential to create global benefits. However, to determine whether address infrastructure should be considered as a global public good, it is necessary to determine whether it is non-rival, non-excludable and underprovided,

and whether it has externalities that make it an impure global public good.

The essential first step in determining whether address infrastructure can be considered a public or a global public good is to establish a definition.[3] It is important to note that a **single address** in itself does not qualify as a public good because it has private characteristics. A single address is a unique point that indicates access and location, a rival good that is unique and unambiguous.[4] Conversely, an **address infrastructure** comprises many unique addresses composed of street names and house numbers, including the linkages between individual addresses. It is the underlying structure that supports the address network. With this definition in mind, the following section analyzes address infrastructure through the framework used to define global public goods.

Is an address infrastructure non-rival?

Individuals or groups can employ addresses across the public and private sectors without diminishing their availability for any other users. Individuals use addresses without rivalry in their day-to-day activities for communicating, finding locations and orienting themselves. At the same time, governments can use addresses as a tool to identify, communicate with and access the population. Public and private sectors may also use address infrastructure to identify clients, provide services, establish communication and develop markets without conflict due to rivalry. Internationally, a reliable address infrastructure can be used for worldwide communication, service delivery and humanitarian aid. Address infrastructure is also non-rival across generations. Intergenerational benefits include the long-term multiple use of the address network. Although some maintenance is required (extension of the system, repairing of signs, accommodation for new constructions), in general, once an initial investment is made in the design, methodology and implementation of the network, it can be left as is.

Is an address infrastructure non-excludable?

Addresses are provided in a standard way that allows for equal access regardless of the status or socio-economic position of the individual. An address infrastructure that is in place cannot be limited to certain users. It can be used by anyone for a variety of different applications. A nationally implemented infrastructure can in fact contribute towards individuals' integration in society by providing them with a means of communicating with other members connected to the network. Government entities are not excluded from gathering information based on addresses to guide and plan their activities. Businesses also cannot be barred from providing their location information to other businesses and consumers or from using the infrastructure to improve communication and exchange. It is therefore impossible to exclude users from accessing address infrastructure once it is nationally implemented.

Does an address infrastructure suffer from underprovision?

Like most global public goods, address infrastructure is underprovided on account of market failure. Its non-rival and non-excludable properties make it impossible to ensure that the costs and benefits of financing addresses remain with the investor. For this reason, providing an address for everyone remains a challenge. However, due to the large importance of address infrastructure for the community, its underprovision often results in the rise of private alternatives: local and partial solutions can be used to bypass the immediate need for an official address; individuals can use other communication devices or their own descriptive addresses; and the public and private sectors can provide identifiers, such as descriptive addresses, plot numbers, water bills, and so on, to provide services, do business and reach their customers.

These alternative systems serve one purpose and lack a global view of the public realm. Several alternative address systems can cause negative consequences for a society, resulting in costly duplicated information and a lack of a common standard system that can be used across sectors. Even more seriously, private addressing systems without nationwide infrastructure may exclude large segments of the population who become neglected and cannot be reached. This results in a range of problems, stretching from confusion within the systems and, for users, lack of a legal identity, insecurity and crime, to poor delivery of basic services and the emergence of informal markets.

Does an address infrastructure have externalities?

Once implemented, address infrastructure has the potential to contribute to worldwide welfare by creating the conditions that aid in the provision of other public and private goods. Although potential providers may only see the initial price of the investment, not all of the benefits obtained by address infrastructure can be captured in the initial investment cost. For example, positive externalities can be seen in the manner in which individuals and the public and private sectors can grow the value of the infrastructure through their distinct uses.

For the individual, an address infrastructure creates externalities by permitting integration into society. An individual with an address becomes part of an interconnected network. This network will become more useful and productive as more people have an address and can use it daily to communicate with others who are accessible through the network. By expanding the number of members who may benefit from larger network coverage, address networks promote inclusiveness and the use of the network for an increasing number of applications (Kaul, 2003). For example, a universal address network permits individuals to use addresses to obtain goods and services such as public services, and to participate in elections and other public activities, which contribute to economic and social development and democracy.

Public sector activities also become more valuable when address infrastructure is used as a tool by a variety of actors across sectors to increase communication and improve cooperation. Databases containing address information can be used across government sectors to improve information sharing and management, thereby making government more effective and enriching information systems. For example, one public organization can use address infrastructure to plan urban growth, which can then help other organizations to plan basic and emergency services that will in turn improve the welfare of individuals and society as a whole. In point of fact, an address infrastructure becomes an information system itself by providing important inputs into city planning and management, service delivery, mail delivery and emergency services provision, among others.

Freetown, Sierra Leone

An address infrastructure also creates positive externalities in the private sector. Better address coverage helps private sector actors to expand their market by identifying and providing access to key customers and facilitating goods and service delivery. The more business relationships are maintained, the more economic transactions are exchanged and the greater the economic development experienced by society. In countries with large informal economic sectors, it is even conceivable that obtaining an address will help informal businesses improve access to potential customers. As economist Hernando de Soto points out, many informal businesses are prevented from participating in a national legal framework because of bureaucratic barriers, such as the inability to prove identity or register at an address (de Soto, 2000). The verification of legal identity by address can thereby provide more efficient access to the market, and could contribute to transforming the informal economy into a formal economy, which in turn becomes more open and transparent.

Can address infrastructure be considered a global public good?

Bearing in mind the properties of public and global public goods, address infrastructure may be considered as an impure public good. The following characteristics of address infrastructure are relevant to the traditional properties of global public goods:

- **Non-rival**. Address infrastructure is non-rival, even extremely so: the more people who have access to an address network, the greater the benefit experienced by the network.
- **Non-excludable**. Address infrastructure is non-excludable: once the infrastructure is in place, everyone can make use of an address without payment of a fee, regardless of socio-economic status. Address infrastructure may even play an integrating role, because it connects vulnerable groups to the larger international system.
- **Underprovision**. Address infrastructure is underprovided: despite the potential for positive societal impacts across policy sectors and borders, addresses suffer from market failure and must be supplied by the government. Other systems may be used instead of addresses, but they lack the multi-purpose potential and global benefit of an official address infrastructure.
- **Externalities**. Address infrastructure has positive externalities: addresses are a fundamental tool to facilitate the provision of public and private goods across sectors. Address infrastructure creates externalities; the greater the number of points connected, the higher the level of available secondary benefits.
- **Global**. Address infrastructure is useful across borders, populations and generations: once implemented it can be used to establish communication with individuals, governments and businesses across borders and cultures. It is intergenerational since the benefits from address infrastructure cut across generations and remain useful for many years, with an address even becoming an attribute of an individual.

With this in mind, address infrastructure can be considered to have properties that place it within the scope of a **human-made impure global public good**. An impure good has properties that allow it to become a private good. However, the potential for address infrastructure to benefit a diversity of users, including individuals and the public and private sectors, means it should be located in the public domain. Implementing an address infrastructure bolsters policies in myriad ways, connecting people, governments and businesses at the local, national, regional and international levels.

Favelha Rocinha, Rio de Janeiro, Brazil

Conclusion

Understanding address infrastructure as a global public good highlights important challenges and opportunities regarding implementation. Address infrastructure should be considered a unique opportunity to provide benefits beyond the individual and the public and private sectors. However, the responsibility for implementing it is difficult to ascertain because it cuts across most public policies and private spheres.

Raising awareness about the role of address infrastructure as a basis for national and global development is the first step in building global consensus around address infrastructure as a global public good. Once it is considered in this way, international guidelines can be created to support its implementation and funding. International guidelines help national governments to implement their own framework for address infrastructure, which can then be translated into local applications at the community level. For example, the issues of slums and megalopolises are specific to the developing world, and as such must be dealt with within the worldview of nations who face these challenges. Address infrastructure cannot be administered the same way everywhere, but certain guidelines can be followed that solve domestic challenges while also providing global benefits. It is therefore necessary that states take the initiative and decide what goods are essential for them and what goods should be made public, taking into consideration the needs of the population and the financial and implementation capacity of the government.

1) Address infrastructure refers not to a single address but to the network of addresses.
2) Although private security systems exist, they do not do so at the same level or scope as national systems.
3) The discussion focuses on address infrastructure; however, this discussion relates to nearly any international system that includes a "location" element, such as the international airport or mobile phone number systems.
4) This reference to an exact point can make an address an attribute of a person's identity, which verifies the person's legal existence, thereby barring its use by any other party. Two concepts are especially important for this definition. On the one hand, an address differentiates individuals who have the same name by linking them to distinct addresses. On the other hand, two places cannot hold the same address within a space (e.g. two buildings located within a city do not have the same street name and house number). If an individual is assigned an address in one area, no other in that area can have the same address unless they live together. In the case that multiple individuals live at the same address, their distinct names serve to differentiate their identities, just as individuals with the same name can be differentiated by their distinct addresses.

Addressing across policy dimensions

Address infrastructure helps to link citizens at local, national and international levels. Comprehensive street naming and house numbering provide a basis for communicating and exchanging physical items, while enabling the implementation of national policies for social and economic development. The previous section made the case for conceptualizing address infrastructure as a global public good. This section illustrates the practical implications of addresses that make them global and public, notably their important benefits across policy dimensions.

Formal citizen identity, efficient public administrations and productive businesses, to name a few, all depend upon the availability of reliable address infrastructure. The ability to precisely locate specific points enables the identification and focused delivery of services within the larger national territory. At the same time, standardized addresses allow for increased interoperability with other networks, creating more value for potential users.

Although the implementation of address infrastructure presents many important opportunities for individuals, governments and the private sector, resources to meet the specific challenges related to implementing addressing policies at the national level are often diverted in favour of more immediate policy needs. However, as can be seen through the following eight policies, by providing a fundamental knowledge base to inform decision making and action, addresses can help to support other critical national endeavours.

I. Governance

Good national governance consists of public sector resource administration that is inclusive, accountable and meets the needs of citizens. For governance to be representative, it needs a reliable base from which to inform institutions. Address data provides one way to optimize the applicability of policies and the ability of governments to identify citizens, reinforce the rule of law, expand electoral participation and support e-government. Although arguments can be made against the use of addresses as an identification tool (such as privacy concerns), without accurate population data policy-makers experience real difficulty in fully implementing equitable social policies.

For citizens, an address means the ability to communicate with the state. Without an address infrastructure, individuals face barriers to their political representation. The lack of access to political institutions yields less representative public policies.

Official civil registration that proves an individual's **legal personal identity** enables a person to take advantage of his or her rights and obligations as a citizen and be recognized as part of a nation. Without such identification, individuals can be barred from using many public services or from moving freely within national territory (Harbitz and Boekle-Giuffrida, 2009). A legal identity confirms an individual's right to access a legal system that proves his or her existence in society and, at the same time, provides the opportunity to claim citizenship. Many nations issue national identity cards or other documents, which constitute proof of the bearer's legal identity, many times including an individual's place of residence. Internationally recognized documents, including passports and visas, also require individuals to be officially registered by personal identifiers, for example, date of birth, physical features and an official address.

Personal identifiers, while seemingly mundane, may exclude individuals with a low socio-economic background, migrants and victims of internal displacement from being recognized as citizens. If individuals have no address, proof of identity or residence, the civil registration process may become out of their reach. An official address helps individuals overcome some of the bureaucratic obstacles caused by their inability to fill out or receive legal documentation that opens the door to their legal identity.

Children attending school in Habilah, Sudan. In many nations an address determines which school a child will attend.

Without addresses, people cannot be identified or reached

In Kenya, an effort by the Ministry of Immigration to issue 5 million national identity cards has been delayed in part because of its inability to distribute the cards. Many cards remain uncollected in the possession of the Ministry because it does not possess an adequate electronic database of addresses that indicates where to send the cards (Gichane, 2012).

For citizens to benefit under the **rule of law** and to exercise their legal rights and obligations, they must be acknowledged and accounted for. Legally recognized individuals have more opportunities to communicate with the state, to participate in government and to make their voices heard. The United Nations Development Programme's Commission on the Legal Empowerment of the Poor estimates that 4 billion people are excluded from the rule of law and that an address constitutes a significant step toward correcting this reality. The establishment of an address infrastructure helps individuals to access their legal rights and encourages people to take advantage of equality before the law. Proving one's residence at an officially recognized address and carrying an ID may be one step in overcoming these obstacles and providing access to the nation's formal legal system.

Participatory **elections** are indispensable for a representative democracy. Larger voter turnout increases the possibility of the electorate being represented and contributes to the quality of democracy (Ank, 2011). However, in many circumstances, segments of the population remain excluded from voting because they do not have an official address with which to register. Despite these obstacles to voter registration, voting remains compulsory in 31 countries (Elliot, 2005) and a constitutional right in 108 countries (Ditkoff, 2011). Penalties for non-participation can be severe, ranging from fines and blocks on drawing salary (Bolivia) to obstacles to obtaining official documents and accessing services such as childcare (Italy).

Addresses also serve to determine the distribution and extent of voter districts by allowing the mapping of a representative population pool, which enables communities to elect representative leaders. Important policies that reflect the preferences of the local population with regard to schools, taxes, development of local services and so on can thus be developed. Voter districts also help to ensure that individuals are registered only in their appropriate residential area, ensuring transparency and discouraging fraudulent registrations. In South Africa, for example, voting districts are determined based on topography, cadastre, census and demographics, with reference to addresses.

The evolution of information and communication technologies (ICTs) has furthered the use of e-services, including **e-government**. E-government has the potential to expand access to government and public administration. It is also expected to enhance service delivery and government efficiency by improving integration and communication across government sectors, as well as extending services at a lower cost. This is especially important in the light of increasingly mobile populations that require more flexible government. Official addresses provide a secure way to confirm one's identity when complying with official e-government requirements, such as when filling out forms, completing legal documents and registering on e-government sites. Because identity fraud presents a growing concern, addresses may also provide an additional means of verification and authentication. Currently, registered letters still play a necessary role in official transactions, but this might change as the use of paper-based forms decreases to allow faster access to services and reductions in paper waste.

In Kolkata, India, the "Addressing the Unaddressed" project affixes a unique code to each dwelling, thus providing an identity for residents.

II. Urban development and management

Rapid urbanization has changed the face of cities, outpacing planning schemes and creating obstacles to further integration between and within nations. Trends in developing countries show that the explosion in rural to urban migration poses problems for both governments and citizens. In order to create resilient cities that can respond to this rapid change, governments must invest in infrastructure that facilitates location of and access to all areas of the national territory and its people. Establishing address infrastructure is one way to reclaim urban areas for future growth and prosperity.

Sustainable **urban planning** requires adequate assessment of the current and future needs of citizens. However, growing urban population densities, intensive land use, insecure land tenure and space constraints challenge the development of sustainable urban plans and threaten future development. At present, a large percentage of the urban poor are effectively disconnected from urban life and suffer from lack of infrastructure and services. In many cases, these urban poor "do not even 'exist' on city maps" (Tibaijuka, 2008), which makes it difficult to build reliable and sustainable public policy or to deliver services.

Address infrastructure helps governments rise to these urban challenges by identifying land and ensuring equal access to citizens. By incorporating communities into an urban plan, inhabited areas can be regulated and land use planned more efficiently and sustainably, especially in the face of limited human, financial and natural resources. Address infrastructure also contributes to other initiatives like spatial information management, poverty mapping, vulnerability assessments and so forth, which also seek to provide information on urban areas.

Rapid urbanization combined with poorly planned and inefficient land use contributes to the emergence of **informal settlements**. These settlements, also called slums, spring up in unregulated areas that have little or no infrastructure, precarious legal rights, and few possibilities for slum dwellers to integrate into the city. Despite these poor conditions, some estimates place around one third of the urban population in slums in developing countries (World Bank, 2009a). Rural to urban migration without the capacity to integrate new arrivals is a key factor in the boom in informal settlements. In addition, the precarious housing conditions of informal settlements often exclude residents from receiving public services. Slum dwellers are being forced to find alternatives to government-provided services that may lack formal access and secured provision, resulting in another form of exclusion. For example, slum authorities or businesses can organize their own system of service delivery for goods such as water, sanitation or electricity; however, water delivery in slums, for instance, may cost 200 times the tap price (UN-Habitat, 2002).

Address data contributes to the planning and monitoring of slum upgrading projects

From 1995–1998, the Government of Brazil established the Habitar-Brasil Programme to finance slum upgrading in major cities. The objective was to combat social exclusion and violence, improving, at the same time, housing conditions in the favelas, including services and facilities, access and circulation. In order to respond to these problems, infrastructures and service networks were made a priority focus of favela upgrading programmes. In spite of these efforts, a commonly cited obstacle was lack of information. Insufficient data on slums and lack of access to favelas precluded the collection and storage of necessary information (IBAM, 2002).

In response to this challenge, Millennium Development Goal 7, Target 11, strives to significantly improve the lives of 100 million slum dwellers. However, rapid urbanization and

A busy street in Sierra Leone. Address data provides critical information for planning public works and transportation.

weak infrastructure have limited the ability of some countries to attain this target (World Bank, 2009a). Proactive policies are therefore required to anticipate the development of cities. Addresses help to map urban areas, which often suffer from a lack of services or government oversight, and enable the implementation of dynamic plans to counteract urban sprawl and exclusion. Address infrastructure presents an opportunity to understand the characteristics of these areas by locating throughways, settlements and dwellings, thereby recording previously inaccessible locations and providing governments with information about the extent of these settlements.

Reliable **census data** is the basis of any inventory of a nation's population, assets and needs. Census data helps to illuminate trends, measure important indicators that monitor development goals, and identify critical areas of concern. Informal settlements, rural areas and other inaccessible areas are often omitted from national census data because of their isolation. These communities are overlooked and remain excluded from policies, programmes and budget allocations. As a result, governments are not aware of the scope of the challenges and have only a poor understanding of the resources required for development, a situation that prevents appropriate action. Addresses help census organizations to undertake their tasks by providing spatial information and facilitating access across the nation.

Reliable census information helps municipalities to better plan services and resources

The UK's 2001 census results showed a large decrease in population as compared to previous estimates, especially for Manchester and Westminster. This drop did not match the expected demand for local services. Only after a private company, specialized in interpreting spatially referenced data, reviewed the census information, was it discovered that the 2001 census undercounted the population by 27,000. These results yielded an increase of 10 million GBP per year in Manchester's Revenue Support Grant (Manchester Geomatics, 2011).

Additionally, census and other statistical information provide a demographic picture of a country, enabling more efficient distribution and development of **public infrastructure and works**. Necessary public infrastructure such as roads and communication systems require an understanding of the composition and preferences of the population. For instance, a combination of census and address data can influence government and private sector decisions regarding where and how much to invest in infrastructure and works such as transportation systems, hospitals, schools and energy systems.

In contrast, inadequate infrastructure can have severe negative economic impacts. In nations without reliable population information, it is generally agreed by development experts that poor quality or insufficient infrastructure reduces urban economic gains. Some countries have undertaken efforts to positively harness urban growth and its potential positive effects on a country. A case in point is the large emerging economies of China and India, which are both rapidly urbanizing and demanding urban infrastructure. From roads to subways and bridges, address data can help to inform policy-makers of the best investments based on demand.

Perhaps the most important factor for individual welfare, especially in urban areas, is provision of **basic services**: running water, sanitation and electricity. At present, many urban poor depend on illegal or unsafe connections. Efforts to expand markets in these areas are prohibitively difficult because of unclear demand and necessity. As with other forms of urban planning, the key is knowing where additional infrastructure for water and sewage pipes or electricity lines is most needed and where they can be built. The absence of

an address infrastructure is a significant barrier to provision of these services, resulting in inability to efficiently organize the production, distribution and consumption.

Conversely, the more extensive the address infrastructure, the larger the percentage of the population that may enjoy access to services, such as water or sanitation.

Addresses help plan basic services

Between 1988 and 1996, Brazil launched the First Water Supply and Sanitation Project for Low-income Populations (PROSANEAR 1). The project consulted with communities in order to tailor efficient and affordable initiatives. In addition to promoting improved water and sanitation, the project helped to create a broad sense of community and greater integration. The project also had the secondary effect of contributing to individual self-esteem, as the introduction of formal postal addresses and water bills enabled participants to consider themselves residents in the society (WSP, 2009).

Water is more difficult to access in the absence of street addresses. With 1.1 billion people lacking access to an adequate water supply, better address network coverage offers an opportunity to improve the sustainable delivery of water with vast implications on human health and development.

Likewise, **sanitation** is an important basic service that has vast implications for the health and dignity of individuals. Poor sanitation negatively impacts the environment and public health, both of which have a direct effect on productivity. In 2008, 48% of the developing world lacked basic sanitation, contributing to disease and social exclusion (UN, 2010). Addressing reduces the spread of disease by supporting sanitation services.

Addressing reduces the spread of disease by supporting sanitation services

Until 1995, Conakry, New Guinea, experienced severe problems as a result of poor sanitation. Roads remained blocked as waste piled up, and the city was especially vulnerable to cholera outbreaks. Addressing proved to be instrumental in facilitating waste collection, zoning waste sites, mapping collection routes, and estimating the number of homes in each collection zone. The city's addressing unit monitored the collection system. The positive results included a 20% to 80% collection increase, a 64% market expansion and a 76% increase in paid bills. Most importantly, as of 1997 cholera no longer presents as an epidemic (Farvacque-Vitkovic, et al., 2005).

Electricity is a basic service whose pervasiveness can affect the ability of individuals to have access to new technologies and conveniences, while also affecting the willingness and capacity of the private sector to develop. Individuals strive to obtain electricity to use basic conveniences such as lights and appliances and for personal entertainment (i.e. to charge cell phones). To access electricity in the absence of formal delivery systems, many individuals turn to makeshift connections that are dangerous, inefficient and inconsistent. Additionally, electricity is a critical component of a functioning business, and businesses are often unwilling to operate in vague localities with poor connections. In this context, the World Bank's Getting Electricity Report cites the lack of reliable address networks as a "time cost" for acquiring an electrical connection (World Bank, 2010). The time to establish a connection may increase and the process may become more complicated if the service connector or the government does not recognize the delivery point.

III. Migration and social integration

Migration is a major factor in the (re)organization of a nation's territory and economic development. Since the 1950s, unprecedented rural to urban migration, inter-urban migration among the poor, and an increase in the number of internally displaced people have caused changes to population distribution and government policy priorities (Gilbert and Gugler, 1992). Many migrants are obliged to install themselves in ghettos or unplanned areas where they have limited access to political representation and public services. As a result, vulnerable and marginalized groups may not feel part of the nation or the community in which they live. This feeling of segregation creates barriers to integration, reinforces poverty, and stunts the economic development of cities that do not have policies to overcome these obstacles. Moreover, weak social cohesion and feelings of marginalization provoke disorder and violence (Rogers and Power, 2000). Where physical addresses exist, they can promote integration by incorporating individuals into a network that allows for information exchange and community building, adoption of a cultural identity, as well as access to education and employment.

Addresses allow individuals to be considered as part of society

In East Jerusalem, hundreds of streets are unnamed and many of the 250,000 people who live there lack addresses. The unnamed streets are a consequence of the city's refusal to recognize thousands of houses built without the correct building permit. As one municipal council member stated: "The underlying message in this situation is that as far as we're concerned, you don't exist, you're not worth even a street name." The issue of identity aside, this lack of an address affects the daily lives of the individuals, who cannot receive official mail, including time-sensitive public notices (Hasson, 2011).

One of the basic characteristics of an address is universality. It plays a role in the **social integration** of individuals because anyone, regardless of socio-economic status, religion, gender, age and so on, can obtain an address. An address grants a sense of identity and dignity and, as mentioned above, can create a channel through which individuals can realize their rights and obligations in society. The act of providing citizens with an address helps to overcome barriers that disrupt access to opportunities.

Since opportunities are offered first to "formal" members of society, many migrants and slum dwellers suffer from poor access to jobs and education and insufficient wages (World Bank, 2008). This daily exclusion makes these individuals a magnet for stereotypes that portray them as dangerous, poor and inferior. In this context, efforts to integrate excluded populations are crucial to upholding the social fabric of cities and preventing social

Children pumping water in Hodeidah, Yemen (Arab Rep.). Better address network coverage offers an opportunity to provide home delivery of public services.

fragmentation and instability. Incorporation into service networks through the simple act of formalizing streets and numbering houses has an enormous integrating effect. Having an address located on a city map and access to public transportation routes helps to enforce perceptions of urban harmony and unity. For this reason, many urban projects include a social integration component, which incorporates the expansion of infrastructure and access. A common first step is the construction of a principal roadway to permit the population to access public services in their area, or to consolidate and improve the secondary road network (Andreatta, 2009).

A sense of shared **culture** can help to create a cohesive and harmonious state. Street naming, in particular, often reflects a shared cultural history or the shared values of a nation. For example, street names can be used to highlight and promote the history and patrimony of the nation through the use of national heroes or symbols. In addition, allowing communities to participate in the naming of streets and allocating names that have cultural importance to them can play a significant role in the integration process.

Address infrastructure aids in the spatial organization of neighbourhoods, facilitating equal access to cultural patrimony and fostering a sense of national pride. Cultural monuments and points of interest become more accessible if everyone can easily locate them. More access encourages the growth of tourism and provides economic incentives to identify, develop and preserve cultural areas. Furthermore, the identification of culturally important areas can generate community awareness of shared culture, thereby ensuring their preservation (World Bank, 2008).

Equal access to quality **education** plays a fundamental role in future development and reduces economic disparities among citizens. In many nations an address is what determines which school a child will attend. Neighbourhoods or districts can divide populations along class or race lines and influence the accessibility and quality of education. The stigma associated with a neighbourhood or a school has repercussions for the educational development of children.

In some documented cases, addresses are rented out or forged so that a child can attend a school in a district that has a better reputation or more resources, or is located in a better area than the neighbourhood school. As a result, preferred schools become overcrowded and the quality of education may decrease, while the state of the remaining schools may worsen. A fair and clear understanding of the composition and needs of the population, illustrated by addresses, plays an important role in improving allocation of necessary resources and thus quality of education.

Employment constitutes an essential opportunity for individuals to escape poverty and instils a sense of dignity. However, living in an area without addresses can be an obstacle to being hired by a formal institution. The lack of proof of residence can be perceived as a stigma by the labour market, with repercussions that go beyond individual discrimination. The economic productivity of society is also affected as individuals are forced to find alternatives in the informal labour market. Participation in the informal economy is often a product of the inability of individuals to meet the requirements of the formal labour sectors, which oblige a legal identity and an official address.

Individuals cannot apply for jobs without an official address

In Japan, the 2008 global recession resulted in many workers being laid off, which prevented them from affording housing. These newly homeless individuals lacked addresses and found themselves unable to apply for employment. One individual, unemployed for months, lamented, "Human resources agencies used to hire contract workers like me without an official address, but that has

changed … Now you need an official address and a guarantor." Innovative attempts to overcome this obstacle in Tokyo, for example, include Cyber@Café, which offers homeless individuals an official registered address (Osaka, 2008).

On top of the bias the absence of an address brings, a lack of addresses also disrupts the critical role of communication in labour relations between employers and employees. Formal employers often require applicants to provide an address in order to ensure communication and payment of salary.

IV. Security

Conserving the integrity of the national territory so as to ensure the authority of the government is a pillar of statehood and a fundamental factor in national security. Development cannot occur in a state of constant fear, as robbery, drugs, violence and murder impede the integrity of the state and community life. Data on the spatial organization of territory and an understanding of the composition of the nation, including knowledge of the population, allows the state to ensure social stability, prepare itself against threats and respond to them.

Police protection is necessary to isolate and respond to threats to the **stability of social order**. The recent growth in urban areas and poverty has been accompanied by a rise in crime and violence. Many urban areas are now considered dangerous and inaccessible, even to security authorities. Access to such precarious areas is fundamental for the protection of all citizens, but an understanding of the particularities of an area or its inhabitants is essential before police can react. Address infrastructure can help identify spatial patterns that highlight crime-ridden areas so that appropriate resources can be assigned to cover these areas and manage the danger.

The internationalization of **organized crime** further emphasizes the need for governments to identify and locate citizens within the population in terms of both national and global welfare. Petty thieves, gangs and organized crime groups take advantage of the inaccesibility of informal and unidentified areas for their illegal activities, making the regulation of national territory and citizen protection a major challenge for governments. Legal documentation and identification based on physical addresses make it easier to take concerted action against these forms of criminality and to form strategic plans to respond to emergencies. In such situations, security personnel must be able to locate and reach an individual and a site swiftly.

Additionally, preventing organized crime groups from operating domestically and across borders is a main responsibility of the government. For this reason, security measures that require individuals to identify themselves and their locations restrict the ability of criminal groups to take advantage of weak infrastructure and poor coordination. For example, when sending a package internationally, a return address has been identified as an important tool to improve security. A false return address can be one of the many indicators that help raise suspicion about a dangerous package. A physical address is critical for identifying senders and being able to follow up when there are problems. An infrastructure comprised of clearly identifiable street names and house numbers, as well as an updated information database, is essential for ensuring rapid response times.

Addresses support compulsory security measures

In October 2010, a package containing a bomb hidden in a print cartridge was sent from Yemen to an address in Chicago. The bomb was identified before any damage occurred; however, in response, the U.S. Transport Security Administration (TSA) imposed restrictive measures on incoming packages. One regulation required that packages to the U.S. over 453 grammes include a known sender (proof of identity and address). For many developing countries this requirement was not possible to meet since many people lack an address. The U.S. security measures resulted in millions of parcels blocked around the world and millions of dollars in losses for Posts and couriers. The UPU is drafting a screening standard that identifies including return address verification when sending packages as a best practice.

National security forces must be able to assess and manage location information in order to respond to threats. In the case of an attack, a primary concern would be maintaining the integrity of critical infrastructure, such as telecommunication or energy. Assessments should be undertaken as early as possible to determine a course of action if one of these infrastructures is comprimised. Address infrastructure could serve as an invaluable tool on which to base decisions about mobilizing security forces, as well as serve as a communication and distribution network. The low-tech and mostly permanent characteristics of address networks make them an infrastructure which cannot be easily destroyed or tampered with, contributing to their reliability in the case of a national security breach.

International humanitarian assistance may also benefit from information based on address infrastructure. When operating in the field, international assistance personnel involved in humanitarian and development activities must be kept informed about the risks of their work. In order to make decisions about operations, existing hazards must be accounted for and a comprehensive plan must be designed. Integrating all of the available information, including spatial information, is a critical factor for making secure decisions. In countries affected by war and insecurity, reliable address infrastructure can facilitate the identification and access of safe havens for victims and personnel. Additionally, in countries where land mines remain hidden, addresses and other spatial tools can help personnel protect themselves and beneficiaries by avoiding at-risk areas.

V. Economy

Quality institutions serve an important role in a country's economic development by establishing the formal and informal rules for ownership and exchange (and their enforcement). Formal personal identification, the rule of law and integrative urban development and social policies help set the foundation for these necessary institutions in areas such as land and property rights, tax systems and trade. However, this foundation itself is supported by the role addresses play as an infrastructure. When linked to governance, law, social policies and planning, addresses help ensure protection of investments for individuals and for the private sector, thereby providing confidence in the economic system. Both the absence of

An informal exchange market in Hargeisa, Somaliland. An official address is often a prerequisite to be part of the formal economy.

addresses and poor addresses can raise the cost of conducting business and can potentially lead to substantial losses.

Poor addressing provokes major annual economic losses

Prior to the implementation of its new addressing system, the lack of accurate addresses in Costa Rica adversely impacted the provision of public services, the tourism industry, the emergency response system and logistics. When calculated for the whole country, annual economic losses were estimated at 720 million USD.

Legally protected formal **land and property rights** are generally considered to constitute a pillar of economic prosperity. In conditions where land users are confident that their property is secure, they have more incentive to invest in property and its improvement. When property rights remain undefined, it becomes more challenging to identify where property lies, where to deliver objects, how to access individuals and businesses and, most importantly, how to verify property ownership. Economist Hernando de Soto defines this property as "dead capital" (de Soto, 2000); it cannot be used as an asset and prohibits access to credit. This challenge mostly affects the poor or middle class in the developing world, who are hindered, without reliable and informed institutions, from attaining the opportunities for improving their economic outlook. Poor land and property rights are also an obstacle for businesses, especially with regard to credit, investment and land ownership transfers.

The identification of an area is an initial step to establishing property ownership rights and to implementing a system of land. Addresses can help to identify and delimit the boundaries of a physical property by becoming the descriptor that identifies the specific access point where a plot of land is located.

Once information on land and property rights is available, it is then possible to create an accurate property register, which can expand the government's ability to establish an effective **tax policy**. In many countries property rights are recorded in a land registry (cadastre) by plots of land. A plot of land is the titled spatial extent of divided territory (legal) with the associated land value and costs (economic) recorded in a cadastral inventory (ISO, 2010). Identifying places of residence or property ownership through addressing enables governments to access potential taxpayers and raise revenue to fund public expenditures (roads, public lighting, water network, etc.). Despite the important role cadastres play for gathering tax information, such projects are often time consuming, complicated and more expensive than addressing projects. Additionally, plot numbers are not well known even by their owners and in many cases do not follow a sequential order or systematic logic, thus making them difficult to memorize.

Addresses can therefore aid in the registration of plots of land and confirm their location for tax and planning purposes. In the case of a poor land tenure regime, tax collection may be hampered because of insufficient information linking individuals to their property. Addresses can add information to property and tax registers to prevent tax avoidance and strengthen the ability of states to collect necessary funds.

Accurate and informative address infrastructure is also critical for **transportation** planning. Information on population distribution (e.g. place of residence, travel time and traffic distribution patterns) can improve allocation of public transport. Addresses can inform transportation strategies and be used in models that evaluate areas with high levels of traffic so as to facilitate the efficient circulation of people, goods and services. This allows companies to determine optimum routes, reducing transportation times and fuel costs. The result is increased competitiveness among businesses and the capacity to deliver products to previously inaccessible or unidentified areas.

Address infrastructure improves distribution

Post Denmark has estimated that the new route-planning tool "TOR", based on geo-coded address data, will reduce delivery costs by 7.5 million EUR every year (Kristensen, 2004). Better addresses lead to better routes, lower transportation costs, fewer gas emissions and fewer problems for the distributor and consumer.

Emerging economies working to incorporate large segments of their populations can greatly benefit from addressing information. India and China, for example, will see transportation and communications become their largest markets by 2025, according to estimates (Dobbs and Sankhe, 2010). Incorporating and accessing these growing populations requires a well-structured and identified transportation and communication system.

In a globalized world, it is recognized that **trade** plays an important role in national development. Improving access to reliable infrastructure creates opportunities for more efficient internal circulation of goods as well as international market expansion. An adequate supply of infrastructure, including address infrastructure, allows for better and more efficient exchange within and between countries by making trade quicker, less complicated and better monitored. This improved trade in turn forms the basis for increased productivity and growth.

Investment in address infrastructure benefits international trade by improving identification of delivery points. Transportation and logistics companies affiliated with mail delivery and address maintenance comprise a large business, and address infrastructure allows these businesses to become more efficient through adoption of improved parcel-tracking utilities, which improve customer satisfaction and ensure better delivery of items. Efficient logistics firms use track-and-trace systems to monitor export and import shipments between countries. The quality of logistics is strongly related to the availability of street addresses. Higher coverage in terms of street addressing leads to the development of more track-and-trace systems, which bring more transparency and higher customer satisfaction. By facilitating the movement of goods around the globe, address infrastructure becomes an essential element of the world trading system.

VI. Commerce

A state's policy towards commerce is a crucial component of economic development. A reliable investment environment for the private sector can improve the transfer of goods and services from producers to consumers. Address infrastructure supports business operations by identifying businesses, ensuring customer access, storing data and facilitating relationships with banks and other financial institutions.

An address can provide an important way of **identifying and locating businesses**, thereby attracting clients. Businesses face difficulties in advertising their location and expanding their business if clients or other businesses are not given contact information, including an address. Better address infrastructure links organizations and increases opportunities for productivity and better delivery of goods and services. Communication between businesses, such as retail chains, magazine services, non-profit fundraising organizations and their customers is restricted without addresses.

Addresses are vital for promoting business operations

The service Google Places allows businesses to post their information online for free. This data will then appear on Google maps when potential clients search the web. Business information including address, hours of operation and other contact information can be listed to help firms expand their client base. However, businesses can use this service only where the Google Places mapping tool is available. Currently, this includes 13 out of 56 listed African countries, 10 out of 37 Asian countries, 1 out of 13 Middle Eastern countries, 2 out of 14 South American countries, and no Central American or Caribbean countries (as of September 2011). This limitation can be detrimental to businesses and creates a barrier to using this otherwise free service for advertising.

The unique identification provided by an address increases its value to business since **marketing** can be directly targeted to the intended audience, saving time and money. It can also help to refine the choice of marketing techniques, as advertisements (and goods) that are popular in one region may not prove successful elsewhere. Data about where and how people live greatly enhances the marketing of products, and conversely, its absence makes it difficult to provide preferred goods to customers or to reach consumers in general (McKinsey Quarterly, 2010).

The creation and maintenance of an address infrastructure also creates **data management** requirements, including the need to develop databases. Good data management is important for many sectors, both public and private. The diversity of database uses can lead to large profits for businesses and government organizations in charge of capturing and storing personal information based on addresses, as well as reduce costs associated with duplicate information. Data such as address, change of name, birth and death, and so on, must be constantly updated to prevent duplicate entries and consequent confusion (Winer, 2009).

Address integration is valuable for public sector information management

EURADIN, the EU's best practice network on addresses, estimates that 60 million EUR per year could be gained through improved address integration. One industry in particular that could make gains is the EU's digital content industry, which supports public sector information (PSI). The overall market size for PSI in the EU alone is around 27 billion EUR (ePSI, 2008).

An official address is often a prerequisite for opening an account at a **bank or other financial institution**. Personal identification information is important to maintain customer relations as well as to uphold the integrity of financial institutions and, in most countries, for compliance with legal requirements concerning money laundering and taxation. In few countries, individuals without an address can use a post office box as a contact point, but this system has many deficiencies, such as multiple users, mail not being frequently collected, and so on, that make it difficult for banks and financial institutions to reach customers. In this context, addresses can be used as a way

A cargo freighter at a port in Korea (Rep.). More reliable addresses foster market expansion and more efficient delivery of goods.

to support a transparent financial system that prevents money laundering and fraud.

Official addresses boost transparency in financial institutions

In Sudan, the new Central Bank law obliges banks to maintain the address information of their clients as part of an initiative to prevent money laundering and combat the financing of terrorism. This information is deemed compulsory for banks to provide access to financial services (Central Bank of Sudan, 2007).

The stringency of bank requirements for opening an account can present problems for those without an address. In its absence, identification must be verified by other documents, such as a land title or utility bills. This is not always feasible and can pose problems for individuals who need access to credit. Name, address, birthdate, place of birth and, increasingly, national ID number are core elements in identity proofing. As countries develop, they must create not only credit-granting institutions, but also the industry that calculates the creditworthiness of individuals and enterprises. Addresses play a very fundamental role in this process.

Tourism constitutes an important source of income for developing countries and provides economic and employment opportunities across sectors. In 2010 alone, international tourism generated 919 billion USD (693 billion EUR) in export earnings and is expected to continue to grow (World Tourism Organization, 2011).

However, finding a tourist location can be difficult without specific information. While residents may be familiar with local landmarks and features, tourists need more precise information. Addresses facilitate visitors' ability to find and reach local attractions and businesses, which can add to the tourism experience and foster local growth. For the vast number of tourists who plan their vacations on the Internet, the comfort and ease with which they can discover points of interest has a large impact on their willingness to visit them. Thus, hotels, restaurants and cultural sites can all benefit from clear addresses.

VII. Information and communications technologies

ICTs comprise a combination of hardware, software, media and delivery systems. They range from televisions and radios to phone lines, laptops, smart cards, credit cards, Internet (e-mail, world wide web), and applications for the modelling and management of information systems. ICTs present an opportunity to reduce governmental transaction costs and expand connectivity to ever-more remote areas. However, barriers such as new costs arising from investment in computers and network connection remain an obstacle, and access is especially difficult in the absence of good infrastructure – both physical and regulatory (Economic Commission for Africa, 1999). In this sense, address infrastructure provides a three-fold support of ICTs: as an alternative to hi-tech systems, which may be implemented unevenly; as a complementary information system; and as an infrastructure upon which to build other systems.

The UPU's constitutional mandate is to support the development of efficient and accessible universal **postal services**, in order to facilitate communication between the inhabitants of the world. As long as an address infrastructure is in place, people can be connected to each other domestically and internationally regardless of their economic status. The postal system is fundamental for promoting equality and access in otherwise marginalized areas. In the case of mail delivery, in particular, accurate and updated addresses are essential to ensure the delivery of a parcel, especially to remote areas where the Post may be the only delivery service. The postal sector can also play an

important role in developing national strategies and promoting global commerce, including by supporting new technologies and pioneering e-services in countries (UPU/ITU, 2010).

Linking physical and virtual addresses expands the Post's role

As part of efforts to revitalize the role of the Post, Tunisia M@ilPost provides all citizens with an electronic address, linked to a physical address. The service acts as a multi-communication platform where citizens can receive administrative documents by e-mail. This service is also used to consolidate the role of the Post, to offer instant notifications and to guarantee the security and authenticity of electronic exchanges.

Mobile phones, especially prepaid phones, play an important role in connecting people where few other services are available, allowing access to services such as text messaging and mobile banking. Prepaid contracts that do not require an address or registration process are the most popular option for individuals in developing countries. Telecom operators also often prefer to be paid upfront, rather than establishing a contract that may be difficult to enforce. However, despite these advantages, not being able to identify and communicate with clients or register phones decreases the opportunity for selling better quality and more services. Address infrastructure can contribute to the development of mobile phone investments by mapping phone distribution and providing a complementary means of communication between clients and businesses.

European legislation requires prepaid phones to be linked with addresses

In 2007, the Law on the Conservation of Data Related to Electronic Communication and Public Networks was approved in Spain, based on the European Union's Directive 2006/24/CE, which seeks to harmonize obligations of publicly available electronic and communication data services for the purpose of investigations or prosecution of serious crime. This directive strives to fight terrorism and organized crime by facilitating the identification and location of individuals. After the law came into force, telecommunications companies in Spain were required to keep personal data (name, address and phone number of registered subscriber) for two years (Gutierrez, 2007).

In the developing world, technologies such as the **Internet** offer great opportunities for expanding access. E-services, in particular, allow for improved government and business services, and are seen as a means to make processes more efficient. Although developed countries have traditionally had a higher demand for the provision of e-services, this is changing as new technologies become within reach of the previously marginalized.

However, practical, economic, social and safety limitations to Internet access still exist. Notably, fixed broadband networks and high-speed Internet connections may be limited or non-existent in poor or isolated areas, creating obstacles to steady personal Internet access (UN, 2010) In many countries, Internet access is not universal and lack of an address can prevent home installation of an Internet connection. Access to Internet connections also assumes that individuals will be literate, have an understanding of search languages, or be comfortable in general with a computer or the Internet itself, which may not be true, especially of the elderly. Statistics show a great disparity in Internet usage within African countries. For example, in 2010, 28% of the Nigerian population used the Internet, compared with only 4% in Mozambique and 12% in South Africa (United Nations Statistics Division, 2012).

E-commerce, the purchasing of goods online, offers individuals many choices through exchange with the larger economy and allows for more dynamic relationships between businesses, customers and suppliers for the better provision of goods and services. However, secure online identities and secure delivery of purchases are important factors in the development of this service. A physical address may be used to authenticate an electronic address used in commerce and communication transactions, for example to validate credit cards, improve the quality of service for delivery of goods and provide accurate identification information. Credit cards in particular require the guarantee of an address before granting their services. Furthermore, once purchased, a tangible good must be delivered to a location, usually a physical address.

Physical addresses facilitate e-commerce

Saudi Post now offers the service "Wasel Aalami". This service provides e-shoppers in Saudi Arabia who buy online in international markets with a personal address in different countries (Australia, China, U.K., U.S.). This facilitates e-commerce by making it possible to shop in countries that require a domestic postal address for delivery. Purchases bought online from websites in these countries will be delivered to the domestic address in that country and then shipped directly to an individual's "Wasel" address in the Kingdom of Saudi Arabia. This is especially useful in the case of certain companies that offer free delivery for domestic customers (Saudi Post, 2012).

The **Global Positioning System (GPS)** has revolutionized efforts to pinpoint locations by assigning precise physical coordinates to geographical positions. The data derived from GPS is a string of numbers interpreted by specialized devices, which are not intuitive to the user. With the help of identifiable and standardized addresses, GPS can be made more user friendly and can be used in an array of devices (ISO, 2010).

A **geographic information system (GIS)** similarly stores diverse data that can be used to analyze and manage geographic information and then present this information on maps. GIS combines data on land use, population, property and so on to form an integrated model that aids in decision making and can be adapted to other data models. GIS can make use of address infrastructure by adding another layer to existing data models to expand applications and observe relationships, contributing to a base of information. Mapping tools such as the World Bank's "Putting the Poor on the Map" use GIS to identify and map the urban poor, so as to create informed policies to alleviate urban poverty by facilitating zoning and the planning of water and sanitation utilities at both the city and the national level (World Bank, 2009b).

Despite the popularity and ease of recently developed technologies, address infrastructure has not been rendered obsolete. The inherent

An open dump site in Manila, Philippines. Addresses can support sanitation services and help reduce the spread of disease.

need for a good address infrastructure is very often underestimated. In fact, addresses complement these technologies by providing baseline information that serves to more efficiently locate places for delivering services, streamlining internal government administration, and linking physical and electronic addresses. These new technologies must be combined with lower-tech solutions to integrate and respond to existing challenges.

VIII. Environmental sustainability and natural disaster management

Environmental concerns are becoming increasingly prominent with the potential for climate change and natural disasters to destabilize national and international populations. Measures to reduce pollutants and degradation form part of evolving strategies for **sustainable development** and are key considerations when discussing natural disaster management. Clearly identifiable and available addresses help to better plan services in an environmentally friendly way, facilitate faster response times in the event of crises, and inform emergency and health services.

Densely populated urban centres provide the opportunity for greater environmental efficiency than in areas of dispersed population, making it possible to implement environmentally sustainable and cost-effective economic and social-development plans. However, as cities grow beyond their set boundaries, they infringe on fragile ecosystems, increasing their vulnerability to disease and natural disasters. Many cities face difficulties in managing resources, and deal with the challenges of pollution generation, precarious housing and municipal service delivery. Poor management of these issues exacerbates the impact on already marginalized individuals.

To ensure that cities are sustainable and resilient, it is important to undertake integrated infrastructure development, beginning with an inventory of the nation's resources. This includes an inventory of parks, nature reserves and other vulnerable or non-constructible land so that the balance between urban spaces and green corridors can be preserved. However, this information base is difficult to create when the extent of the nation's territory is undocumented or inaccessible. Address information can support the appraisal of a nation's resources by identifying and mapping the systematization of city sprawl to facilitate the urban and resource planning.

Tackling the pollution caused by excess transportation is one way to improve the sustainability of cities. In many developing countries, cities contribute significantly to air pollution. However, this problem is not without remedy. It is estimated that 56.6% of anthropogenic greenhouse gas emissions come from CO_2 generated from fossil fuels (IPCC, 2007). It is estimated that the CO_2 emissions of trucks alone could be reduced by as much as 30% through improvements in the operational efficiency of goods distribution (Cadena, Remes and Restrepo, 2011). Poor maps and poor street signs force drivers to travel excessive distances in order to locate delivery points. Finding better ways to get from point A to point B helps to reduce time spent and health and environmental costs. A system of clear routes, labelled streets and identifiable houses provided by correct addressing is just one way to lay a foundation for a resilient city.

Address infrastructure helps monitor energy consumption

In 2010, Sweden passed a law requiring energy companies to report on the energy consumption of their clients. The purpose of the law was to accumulate data on the energy consumption of buildings, as a step towards reducing CO_2 emissions. (Action can then be taken based on data from buildings with the greatest energy-savings potential.) Companies are required to present yearly reports on their consumers' consumption, which is

merged with address data and stored in the National Building & Dwelling Register (Misser, 2011).

Resilient cities reduce the risks associated with **natural disasters**. The Japanese tsunami, the Haitian earthquake and the Pakistani and Chinese floods highlighted the vulnerability of human beings and the devastating effects that natural disasters can have on a nation, leading to financial, environmental and human losses. Securing infrastructure and services, and understanding the safety needs of the population enables planners to greatly mitigate the outcomes for those affected by disasters.

Disaster preparedness involves the identification and mapping of vulnerable areas, in order to help assess risks and their drivers and to reduce the impact of natural disasters. Most importantly, disaster preparedness means having an effective response in the case of a disaster. Accurate information is crucial for organizing a timely response, especially in terms of humanitarian relief. A database with reliable information, including address data, provides an excellent information base for disaster damage control by helping nations to rapidly mobilize resources after a disaster – time that can mean the difference between life and death for affected people. When disaster strikes, practical strategies for delivering goods and services must be in place.

Address infrastructure also helps in the management of information, which can be coordinated and exchanged at different levels of government, and during the distribution of aid. Databases that use addresses can help to link location data with personal identification details and information on vulnerable segments of the population. Examples of critical data points include the total number of people living in a neighbourhood struck by disaster, and the number of children and elderly expected to be in the affected area (Panda, 2011). It is important to note that while disaster areas can be documented by satellite imagery, this information is not linked to data on citizens per household, street or neighbourhood, important buildings such as health facilities or basic infrastructures, age or other personal information that could help in providing appropriate relief.

Crisis response is not isolated to natural disasters. The response of **emergency services** is also time sensitive. Identification of a location and the best route to access it are crucial for rapid response times. Street names and house numbers greatly facilitate the ability of emergency response teams to reach an affected area.

Address information is vital when human lives are in danger

It is estimated that across the European Union between 4% and 9% of individuals transported by emergency services die en route from the incident site to the hospital. A contributory factor in the number of deaths is long transportation duration. Although the trip time between the incident site and the hospital should be fixed at 10 minutes, this has been found to be true in only half of cases (Quoidback, Nicholson and Fisher, 2009).

In addition to reaching vulnerable areas rapidly, emergency services need to be able to identify the people involved in a crisis. Information detailing house numbers and residents is crucial in this regard; without such data, calculating the people affected becomes difficult. This is even truer of informal and unrecognized settlements, whose inhabitants in many cases are not registered.

Poor **health** and the spread of disease are exacerbated by poor living conditions and inadequate response and treatment, and are intensified by natural disasters. During disease outbreaks, response teams must be able to locate the source and spread of the disease, and be able to physically go to the area and control it. In some countries, addresses have enabled health authorities to map outbreaks. These maps can then be used to locate contaminated water sources, thereby saving lives and valuable resources. Health information can be stored with addresses so that patterns identifying susceptible neighbourhoods and streets may be considered in future planning. Addressing and GIS data, in particular, offer opportunities to identify areas vulnerable to health threats. Data on physical addresses assist teams to quickly and accurately locate healthcare facilities by identifying the quickest route and available services, as well as improving the capabilities of organizations to provide aid. One database, the Global Healthcare Facility, has been used to hasten reaction time in the case of natural disasters. The database contains the up-to-date address and coordinate data of health centres. The information is intended to be geographically interoperable and publicly available.

Properly locating health facilities benefits those most in need

In the United Kingdom, complete address data has been used in conjunction with private sector demographic data to locate new health clinics in emerging immigrant population centres, so as to serve those populations in the most cost-effective manner.

Public health campaigns serve to promote crucial awareness of measures that help prevent the outbreak of disease, and to provide information about existing social and environmental issues. In many developing countries, weak health systems make public health campaigns indispensable for communicating with the public, in particular so that vaccinations, medicine distribution and information dissemination can be targeted to vulnerable groups. The ability to reach and inform people greatly facilitates invaluable health and prevention activities. For example, a database that enables voluntary follow-up for HIV/AIDS cases can help people to access information about where to get treatment in their area and help health centres to track disease evolution. In this way addressing can be used as a tool to fight the spread of illness and disease.

Conclusion

Address networks go far beyond the postal sector; they are the crucial information that constitutes an underlying infrastructure upon which many other services can be built. They are a significant step in connecting people to public and private services. The lack of an address infrastructure has a wide range of undesirable consequences for individuals and for the nation as a whole. Barriers to address infrastructure impede many normal functions of the state and opportunities for development.

A mother and her children retrieve aid supplies in Cazula, Mozambique. For war victims and humanitarian personnel, address infrastructure can help map out safe havens.

Individuals, governments and businesses all have a stake in the use of address infrastructure.

Inequality, growth and addresses

A lack of addressing infrastructure, combined with more complicated trade and bad governance (see Figure 1), can be a factor that worsens inequalities and undermines economic growth. Indeed, there is a positive correlation between a lack of street addresses and income inequalities (see Figure 2), as well as a negative correlation between a lack of street addresses and the income per capita in a country (as measured by the gross national income at purchasing power priority).

The political will to expand the coverage of an address infrastructure can help to overcome many major development challenges. However, building address infrastructure requires a common awareness and action plan that is supported at the local, national and international levels. Political willpower is the key to guaranteeing that an address infrastructure is developed for the benefit of all. Investment in address infrastructure is investment for the good of the national economy and the body politic.

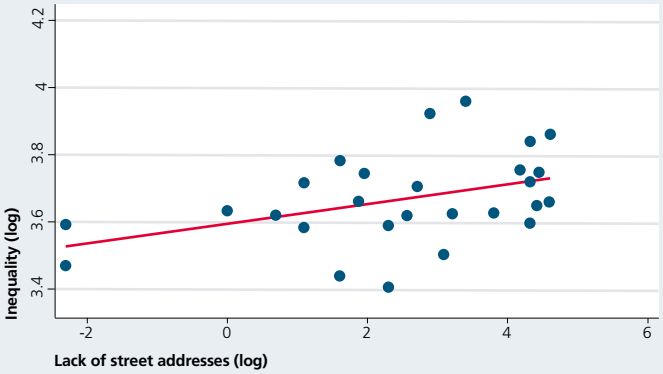


Figure 1

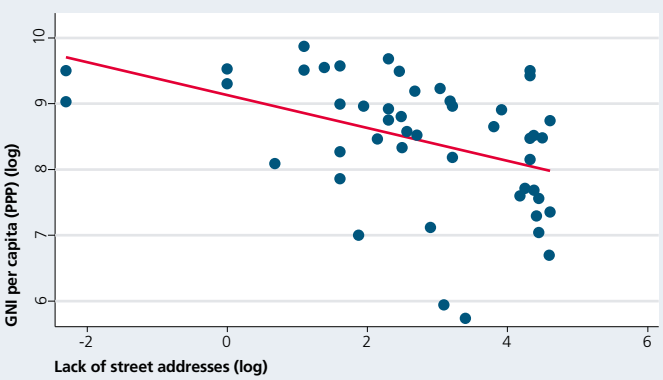


Figure 2

Rural area in Songea, Tanzania

Part II

Addressing policy as a nationwide effort

Case study: Tanzania

Overcoming obstacles to addressing in Tanzania

Rural area in Songea, Tanzania

Tanzania Communications Regulatory Authority (TCRA)

Shortcomings of the current addressing system

The United Republic of Tanzania is located in East Africa and was formed out of the union of two sovereign states, Tanganyika and Zanzibar. The Ministry of Communications, Science and Technology is responsible for the postal sector.

Tanzania lacks a coherent addressing system that identifies individual streets and buildings. In place of this, mail is delivered to post office boxes. The designated postal operator, Tanzania Posts Corporation (TPC), has installed a total of 173,000 post office boxes countrywide. However, this number is insufficient to meet the current demand for addresses, taking into account the size of the country and its population and number of households.

The absence of a proper addressing system is an obstacle to the postal sector's efforts to make a significant contribution to the socio-economic development of the country. The current system has a number of shortcomings. At present, post offices are unable to fully satisfy the demand for private letter boxes in major cities and towns. As a result, individuals must share post office boxes – often those belonging to churches, mosques, schools, workplaces, friends, and so on. There is a lack of standardized addresses, and attempts to apply street addresses often involve lengthy descriptions of locations that lead to confusion. As a result, mail is missorted and misrouted. Consequently, the system is unsuitable for the demands of e-commerce.

Evolution of the national addressing and postcode project

Research and studies carried out since 2001 have underlined the need to modernize the postal addressing system in Tanzania. The Government has subsequently undertaken efforts to reform the postal sector in line with the UPU's Seoul Postal Strategy.

In 2003, the Tanzanian government formulated the National Postal Policy to develop a physical addressing and postcode system. Its principal aims were to achieve standardized address information, enhance mail processing and delivery, reduce undeliverable-as-addressed mail, and provide mutual cost-reduction opportunities to the business sector by improving mail efficiency.

The Swedish International Development Agency (SIDA) provided assistance with the formulation of the policy. In 2007, the UPU carried out a second study to ascertain the best strategy for implementation of the project with a follow-up study conducted in 2008. The studies confirmed the feasibility of developing postcodes for Tanzania and provided guidelines with appropriate steps by which

to implement the system. The Government also recognized the wider economic and societal benefits of the new addressing and postcode system.

Mandate and objectives

Following identification of the weaknesses of the existing postal addressing system, the new policy emphasized the need to establish a new addressing system to meet the diversified needs of customers and boost the postal sector's contribution to national development. The central objective of the project is to implement, by 2015, a street-type addressing system with postcodes, in line with the National Vision 2025. The immediate objective is to provide an address to every house and location in the country within a period of five years. The implementation process will comprise several tasks, in particular:

- The installation of street signs and house numbers in urban and rural settlements;
- The development of a standardized physical addressing system. This will increase postal sector productivity through improved address accuracy and mail delivery efficiency, minimizing the number of undeliverable items and resulting in increased customer satisfaction. A standardized addressing system will also increase the possibility of machine processing both inward and outward mail items and the integration of other modern postal systems;
- The development of the National Addressing and Postcode Database.

Key project stakeholders

Studies and consultations with stakeholders resulted in an agreement that key institutions from the Tanzanian mainland and Zanzibar would be involved in governance and management of the project (see box). The Ministry of Communications, Science and Technology (MCST) would act as the lead institution, with this role undertaken by the Ministry of Infrastructure and Communication (MoIC) in Zanzibar.

Key stakeholders

- Ministry of Communications, Science and Technology (MCST);
- Ministry of Home Affairs (MOHA);
- Ministry of Infrastructure and Communication, Zanzibar (MoIC),
- Ministry of Lands, Housing and Human Settlement Development (MLHHSD);
- Ministry of State President's Office, Regional Administration, Local Government and Special Departments – Zanzibar (MRALGSD);
- Ministry of Water, Construction, Energy and Lands, Zanzibar (MoWCEL);
- National Bureau of Statistics (NBS);
- National Identification Authority (NIDA);
- Prime Minister's Office Regional Administration and Local Government (PMO–RALG);
- Tanzania Communications Regulatory Authority (TCRA);
- Tanzania Posts Corporation (TPC).

The project steering committee is the project's top decision-making body. It comprises the permanent secretaries of key stakeholder ministries from the Union Government and the Zanzibar Revolutionary Government.

The project team comprises middle-level officials from the key stakeholder ministries of the Union Government and the Zanzibar Revolutionary Government. The project team meets on a quarterly basis to review progress of the project and agree on future project activities. The project team reports to the project steering committee on a regular basis.

The project technical teams are ad hoc teams comprised of members from the key stakeholder ministries, set up to perform specific/technical tasks requiring certain expertise. These include preparation of the street addressing manual, allocation of postcodes, development of the national addressing standard, and preparation of specifications for the national addressing and postcode database.

The Ministry of Communications, Science and Technology (MCST) is the Ministry currently responsible for the postal sector and for overseeing the project. It coordinates with all relevant ministries and authorities on cross-cutting issues to ensure successful implementation of the new addressing and postcode system. The Ministry is also responsible for chairing steering committee meetings and functions, most importantly, as the project's official sponsor.

The Tanzania Communications Regulatory Authority (TCRA) spearheaded implementation of the project. The Authority houses the Project Secretariat, which is responsible for maintaining the national addressing and postcode database and acts as the custodian of project documents. The Authority also coordinates postcode project team meetings and the public awareness campaign.

The designated postal operator, Tanzania Posts Corporation (TPC), controls the largest postal network and will be a major beneficiary of the new addressing and postcode system. TPC is therefore required to renovate its sorting offices and review its mail circulation systems in order to keep pace with the new postal addressing system and be in a position to provide door-to-door delivery service.

Street naming and house numbering committees will manage the project at the municipal level. Each committee will comprise: a town planner (chairperson), a civil engineer (alternate chairperson), a cartographer, a surveyor, a postal officer (secretary), a community development/social welfare officer and any co-opted professional member. The committees are responsible for address assignment and address data capturing, verification and maintenance. Clean data will then be posted to the national addressing and postcode database. The committees are also responsible for updating address maps within their municipal boundaries.

Human factors

The success of a project of this nature depends on certain important factors that must be critically examined and appropriately managed. One of the critical issues is human resources. Human factors and challenges can be divided into three groups: professional differences, human resources development and competing interests:

Professional differences. Since the beginning of the project, there have been significant professional differences of opinion between postal and town planning officials; for example, town planners objected to the allocation of new numbers to houses rather than existing

plot numbers. The new house numbering system was adopted owing to the fact that the plot numbering structure, which depends on a block system, lacked consistency.

Human resources development. Training of postal staff (including couriers) is of paramount importance in order to realize the project's goals. Sorting office staff and couriers (delivery and pick up) will play a crucial role in its success. Furthermore, postal customers and the general public must have a good understanding of the new addressing system for it to work and to avoid confusion. Internal and external training and capacity-building programmes have been designed to impart adequate knowledge of the new addressing system.

Competing interests. The project involves a wide range of people with varying needs and expectations. Although team members meet as a project team, each person gives priority to his or her primary field of interest and employment. At times, project leaders are forced to convene meetings in secluded places to expedite the execution of particularly pressing tasks.

The new system

The new national addressing and postcode system aims to establish an addressing system that will enable identification of individuals or businesses by their physical location and postcode. The project seeks to implement a street-type addressing system with postcodes and to create a national addressing database for Tanzania. It will involve street identification and naming, all houses will be numbered according to the new addressing standards that have been developed.

Tanzania has adopted a **numeric postcode system**. The country has been divided into seven postcode areas/zones, and a five-digit postcode system has been used to allocate codes at the level of individual wards, which are the smallest administrative entity. Postcodes have also been allocated to post office locations, major postal customers and landmarks, as illustrated above in Figure 1.

Tanzania Postcode System

Postcode	Explanation	
2 3 1 1 0	**5 Digits Postcode**	
X – – – –	**Zone**	*1st Digit*
X X – – –	**Region** (Province)	*1st + 2nd Digit*
X X X – –	**District**	*1st + 2nd + 3rd Digit*
X X X X X	**Ward** **Post office** **Big Mailers** **Landmarks** **Activity**	All 5 Digits

Figure 1: Coding method

Benefits of the new system

The new national addressing system will have multiple advantages for Tanzania's many stakeholders. It is expected to positively affect socio-economic life and security and safety throughout the country, particularly in the following areas:

- **Vital records**. It will be possible to maintain correct and updated data on populations in the municipalities.
- **Health services**. Ambulances will be able to locate appropriate addresses more rapidly.
- **Rescue services**. Fire brigades will be more effective if they can reach an area before major property damage occurs.
- **Law enforcement**. The identification of various geographic and crime areas will facilitate policing and the keeping of proper records of inmate addresses, etc.
- **Improved navigation**. City areas will become more recognizable, simplifying the movement of city dwellers and visitors and laying the groundwork for the creation of Global Positioning System (GPS) navigational data.
- **Trade**. E-commerce transactions over the Internet will become possible.
- **Revenue**. It will be easier to collect taxes (e.g. on motor vehicles, properties, advertisements, etc.)
- **Civic life**. The system will help to reinforce national unity and a sense of identity.

A number of sectors also stand to benefit from the addressing system.

The postal sector

An address for every household and location in the country will help to achieve the objective of the worldwide initiative "Addressing the world – An address for everyone". Mail sorting will be easier and more efficient, and missorted, misrouted and undeliverable mail will be minimized. The system will include preparation for the possible automation of the postal sorting, and new postal products related to the new addressing systems could be introduced. The sector could also benefit from a rise in revenue as a result of increasing advertising mail volumes and the delivery of e-commerce items through the postal network.

Other sectors

The new addressing system will benefit the **government**, by providing addresses to individuals that currently lack them (e.g. rural and unplanned settlements), thereby facilitating the delivery of economic, social, security and other services to every citizen. The new addressing system will also constitute a reliable source for address verification when issuing national identity cards.

The system will help **financial institutions** by facilitating services such as the granting of

National addressing standard

For the purpose of establishing the national addressing standard, addresses were categorized into four main types (urban, rural, postal delivery and international), as described in the following examples:

Urban address

Regional manager	*Name of addressee*
Arusha Head Post Office	*Building name*
1 Boma Street	*House number + street name*
23100 Arusha	*Postcode + locality*

Postal delivery

Mr Peter Mhina	*Name of addressee*
P.O. Box 25	*Post office box number*
20267 Muheza	*Postcode + post office*

Rural address

Aloyce Lwambano	*Name of addressee*
12 Mazengo	*House number + hamlet*
Matonya Village	*Village name*
41521 Galigali	*Postcode + locality*
Mpwapwa	*District*

International address

Jackson Massawe	*Name of addressee*
45 Kipanga Street	*House number + street name*
23115 Kaloleni	*Postcode + locality*
Arusha	*District*
Tanzania	*Country*

Figure 2: Address examples

loans, which ideally should be based on reliable references and addresses.

Tourism will also improve as tourists become increasingly able to identify locations such as hotels and key landmarks using Internet maps.

Major implementation steps

There are several major steps in the implementation of the project :

Formation of the project structure. As mentioned above, the project secretariat, project steering committee and project team are established with specific compositions and responsibilities. The steering committee is the project's top decision-making organ, comprising the permanent secretaries of key ministries from the Union Government and Zanzibar Revolutionary Government. A project team manages the project and reports to the steering committee on a regular basis.

Formation of street naming and house numbering committees at the municipal level. These committees are established in each municipality, and are mainly responsible for coordinating and overseeing the implementation of activities at the local level.

Training of project implementers. Persons involved in establishing street signs, house numbers and data collection are trained at the outset of the exercise to ensure the standardized appearance of street signs and house numbers, as well as the quality of address data. The trainers are members of the street naming and house numbering committees. Other groups involved include the ward executive officers and casual labourers hired by the municipality to collect address data.

Advocacy and awareness-raising. The new addressing and postcode system is a completely new phenomenon for the majority of Tanzanians, and therefore requires a strong public awareness campaign. The importance of raising public awareness through radio, television and print media has been identified as a vital project component and a priority task. Seminars and workshops have been held for the National Assembly, Zanzibar House of Representatives, permanent secretaries, ministries, municipal councils and the National Identification Authority (NIDA), as well as with postal operators, major postal customers, universities, colleges and schools.

Tenders and procurement of materials and software. Materials for street signs and house numbers, as well as computer software and hardware for the addressing database, purchased in accordance with the Procurement Act.

Project execution. The physical execution of the project began in its pilot phase in 2009, involving seven wards in the Arusha municipality. This was extended to Dodoma in 2010. Implementation activities included the establishment of street signs and house numbers, data collection, and the creation of an address database for the pilot project areas. Digital maps were subsequently updated. Final preparations are underway for further implementation in the three municipalities in the Dar es Salaam region, namely Ilala, Kinondoni and Temeke, and the Zanzibar municipality and town councils.

Establishing street signs and house numbers. All public streets must be named and houses numbered in accordance with the provisions of the Street Addressing Manual, developed to assist municipalities in carrying out this assignment independently. The manual provides guidelines on the formation of street addresses.

Data collection and building of the address database. Data collection should be a continuous process. It involves meeting house owners and/or tenants to gather information that will constitute the core of the address database. These data aim to serve as the basic information for identification of house entrances, facilitating delivery of services, including door-to-door mail delivery, water and electricity provision, tax collection and rescue services. Existing information may be used

Street signage in Arusha, Tanzania

pending the development of official information; for example, plot numbers assigned by the municipality may be used as substitutes until new house numbers are assigned.

Creation of postcode area maps and street address maps. Postcode area maps show postcode boundary areas (e.g. regions/districts/wards), each with its own postcode number. Street address maps display street names and house numbers, as illustrated in figure 3.

Official inauguration of the new national addressing and postcode system. The project was officially inaugurated in Arusha on 18 January 2009 by His Excellency Dr Mohamed Ali Shein, Vice President of the United Republic of Tanzania (and current President of Zanzibar).

Challenges and measures

There are several challenges to the implementation of the new addressing system:

- Many urban areas lack street names, signage and house numbers. Where they do exist, they are not presented in a logical and/or consistent manner.
- Cities and suburban areas are characterized by poor urban planning, which increases the difficulties associated with the implementation of addresses.
- There has been an increase in unplanned settlements in urban and suburban areas on account of urban migration, and the lack of strict regulation for property development.
- There are resource and data-sharing problems among stakeholders. Many institutions, including local governments, the Revenue Authority, the Permanent National Voters Register, the National Identification Authority, among others, maintain their own databases, which are tailored to their particular needs. There is a need to integrate incompatible databases to allow for data sharing and the maintenance of accurate and consistent data.
- The project requires significant funding to manufacture the street signs and house number plaques to be erected by local governments. Other activities relating to the collection and capture of data and database maintenance also require financial support.
- The lack of village settlement planning creates particular challenges for the adoption of special numbering and the assigning of rural addresses.
- The establishment of a credible national addressing system will require the review of certain laws and by-laws. This process may take a considerable period of time.
- Infrastructure has been vandalised; in particular, signage and sign poles have been damaged or stolen for their materials.

The Government has taken a number of measures to mitigate challenges to project implementation:

Funding. The Government has funded the initial implementation of the project through the TCRA, with additional funding expected from future government budgets. The Government has made requests for funding to development partners, financiers and sponsors, and is expecting positive responses. The Government has reminded municipal councils of their responsibility to name and label the streets in their areas of jurisdiction, and they are expected to set aside a budget for this purpose.

Enhancing the performance of the public postal operator. The Government is currently taking measures to re-engineer postal services in the country. It has taken over the debts of the public postal operator, which has enabled the operator to implement certain key elements of the new national addressing system. The public postal operator has formed the Postcode

His Excellency Dr Mohamed Ali Shein launching the new national addressing system in Arusha, Tanzania

Figure 3: Street address map in Kaloleni Ward. Plot numbers are given in black, house numbers in red.

Project Team in order to develop implementation strategies within the Post and oversee the implementation process. TPC has already started to train its staff on the applications of the new addressing system, including sorting office rearrangements, door-to-door delivery, and so on.

Legislative review. The legal framework evolved significantly in 2010 with the passage into law of the Electronic and Postal Communications Act (EPOCA). This new regulatory law for the communication sector assigns responsibility for managing the national addressing and postcode system in Tanzania to the TCRA.

Conclusion

A country must have the political will to successfully implement a physical address and postcode system. It must be aware of the important role the political structure plays in mobilizing people and reviewing legal instruments to facilitate implementation of the project. In addition, the project must take into account of the involvement of key stakeholders who have important individual roles to play.

Current implementation of the project is on course with significant progress in both the pilot phase and phase one. Such a project has significant implications not only for the postal sector, but also for the social and economic fabric of the country. Planning a postcode system requires sufficient time, great care and even greater vision. Awareness raising and communication of the project to stakeholders remains one of the biggest challenges.

Nyhavn – Copenhagen, Denmark

Case study: Denmark

Improving an addressing infrastructure: the Danish experience

Danish Enterprise and Construction Authority (DECA)

Since 1996, Denmark has significantly developed and enhanced its addressing system. It has simplified and enforced the relevant legal regulation, and appointed and empowered authorities responsible for assigning and maintaining road names and house numbers. The authorities have changed existing road names to avoid duplication, and improved the quality, registration and management of address data held in the national address register. Most importantly, use of the addressing system has increased significantly in public administration, local communities and the commercial sector. Denmark's experience provides an example of the significant benefits to society of a well-formed addressing system. This study presents the most important milestones and achievements during this process, as well as the experiences gained and lessons learned.

Historical development of the Danish addressing system

The first addressing system was introduced in Denmark between 1850 and 1900, initially in the capital city of Copenhagen and later in other major cities. Addresses followed a systematic odd and even numbering of buildings and properties along every road. In 1967, a national four-digit postcode system was introduced by the national post service, Post Denmark. Soon afterwards, in the 1970s, road names and house numbers were extended to cover the whole country, from minor cities, villages and summer cottage areas to rural areas. These road names and house numbers replaced the traditional name of the village, hamlet, estate or farm as the primary place identifier (Lind, 2004). By around 1980, all roads had been named by the local municipality and all developed properties had been assigned at least one house number. At that time, house numbers were limited to numbers ranging from 1 to 999 with an optional uppercase A–Z suffix.

As a part of the Danish addressing system, all roads were identified by the four-digit code of the municipality and a four-digit road code. Thus, the combination of municipality code, road code and house number formed an unambiguous identifier for approximately 2 million "entrance-door level" addresses in Denmark.

To identify individual dwellings within a multi-family storey building, a common concept for "floor and door" identification was approved in 1978 and accepted both in the public registries and for postal addressing purposes. This new concept enabled the unambiguous identification of a unit-level address for dwellings and business premises (Figure 1) and led to a common, well-known and standardized address format. As a consequence, the Post, gazetteers and telephone directories

used the same address identifiers (road name, house number, floor and door identifier and postcode) to form addresses.

In the 1980s, this common address format was the basis for coordination and data interchange between three main public registers: the Danish population register (CPR), the building and dwelling register (BBR) and the property assessment register (ESR). In the 1990s, the business entity register (CVR) also adopted this common address format (Figure 2).

This coordination and joint use of the addressing system resulted in a number of benefits. For example, CPR and BBR data alone enabled Statistics Denmark to carry out censuses several times a year; data interchanged between BBR and ESR formed the basis for property taxation; and social security services could combine personal information from CPR with information on housing conditions and properties from BBR and ESR.

Figure 1. Original Danish address format

The inconsistencies in the registers raised the question: Are addresses the property of the parties that use them, or are they a common asset for society?

For example, customer databases can manage addressing data as an attribute of customer information, or record the information independently and link it to customer records. If the second approach is employed, the address table can be reused for additional purposes, for example, linking employees or suppliers to the relevant addresses.

During the 1980s, the predominant tendency favoured the first approach. With very few exceptions, address information was managed and updated in the database as a simple attribute, on par with other "soft" characteristics. A problem with this approach was that it encouraged each user or authority to build its own independent address register, without any link to the registers of other users and authorities. This resulted in inconsistencies

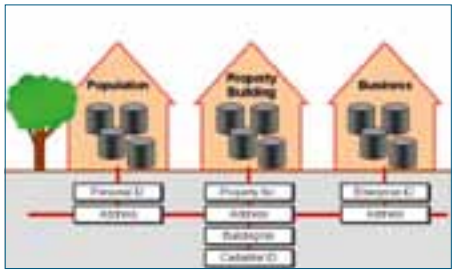


Figure 2. Linking public registers by the address identifier

A new conceptual model

In 1995, the modernization of the building and dwelling register brought these inconsistencies to light. It was decided that the obvious solution was to define the address as a *common asset*. As a consequence of this approach, an address would exist in itself and no longer be a simple attribute of a building, plot of land, business entity, and so on. This provided a high degree of flexibility: a new address could be created and registered whenever appropriate, for example, in the planning phase prior to land division or building construction.

The approach was based on the principle that there were no "addresses at random". Instead, an appointed custodian (e.g. the local authority) would maintain finite sets of reference addresses. This approach encouraged address information sharing and exchange between different registers, as each would be referencing the same standardized address dataset. The concept of the address as an asset

Figure 3. Inconsistency in various registers

Shortcomings of the address system

In theory, from the 1990s on, Denmark should have been perfectly positioned to benefit from its solid addressing system, based on a commonly accepted address format suitable for address rendering and address data exchange. Experience showed, however, that the existence of a common address format did not guarantee the consistency of the data in the various registers (Figure 3). For example, address information from the central business entity register, based on reports from businesses themselves, did not correspond well to addresses recorded in the building and dwelling register, which were maintained by the municipalities.

given that the same property, building or business was registered with (sometimes slightly) different addresses in different registers.

More importantly, the approach promoted a situation in which each administrative system created its own understanding of addresses, so that different address definitions and structures arose. Consequently, each register attempted to define, justify and sometimes also promote its own "type" of address as something special (e.g. dwelling addresses, property addresses, utility addresses, business addresses), thus undermining the cross-sector and multipurpose aspects of the addressing system.

of its own could serve multiple purposes within society's infrastructure. Moreover, the appropriate authority or custodian could manage the constituent identifiers (e.g. road names and house numbers) in a single register. This also applied to other relevant characteristics and attributes connected to each address, such as author, date of origin, quality and geographic location (coordinates, address point). Address data from an official address register could provide a *common reference* for users to download or link to from IT systems.

From the practical point of view of government, the approach also raised a number of **challenges**:

- An authority for the creation and maintenance of the addressing system (e.g. local authorities) and a custodian

for a common address register had to be appointed.
- A basic framework of rules and standards had to be defined in order to maintain a certain degree of harmonization and quality of the addressing system.
- A certain amount of public funding had to be available, and there had to be mechanisms to ensure the transparency of addressing systems. Furthermore, the address register's data had to be accessible for users under equal and appropriate conditions.

However, it is important to note that the total socio-economic cost of maintaining this new approach would be lower than that of a situation where each authority and private business collects, maintains and updates its own (competing) address dataset.

Enforced regulation and authority

On the basis of agreed consensus, the Government enforced public regulation on addressing in the late 1990s. Several ministries agreed that legal regulation of the addressing system and the address register would be guided by two principles:

- The Act on Building and Dwelling Registration (BBR Act) would constitute the legal framework for the addressing system under the purview of the Ministry of Economic and Business Affairs.
- Local authorities would be appointed as address authorities, thus giving the municipal council the responsibility and power to assign road names and house numbers, and to maintain address data.

In 2001, these principles came into effect with a revision of the BBR Act. Today, the regulatory framework for Danish addressing is comprised of four components: (i) the general legislative framework, (ii) detailed rules of addressing and address data, (iii) guidelines, examples and best practices, and (iv) other user information resources. Additionally, the BBR Act empowers the Minister to implement more detailed regulations, a responsability that was subsequently delegated to the Danish Enterprise and Construction Authority (DECA).

The legislation required the elaboration of a definition for the term "address". The following definition was prepared: An address is an independent administrative object that identifies a specific way of access to a property, building, technical facility or the like, in relation to the road network.

There are several key words in the definition:

- **Administrative object** indicates that the address is assigned according to certain rules by a public authority as the result of a conscious and administrative decision.
- **Identifies** indicates that an address provides an identification of something definite in the real world (like the name of a lake references the lake itself).
- **Specific way of access expresses** that the object identified by an address is not the object itself, but the access to it (i.e. the access to a property or building).

The last part of the definition also clarifies that buildings with several entrances may have more than one address, and that a building or plot with physical access from two roads may have addresses on each of these. The Danish address definition has many similarities with other national and regional address standards (Coetzee et al., 2008), but also some differences, for example, it focuses on "way of access". This formal semantic definition enables a common understanding of addresses as an asset for society to acknowledge, share, maintain and improve for the benefit of all.

The 2007 Statutory Order on Road Names and Addresses supported this definition, formally outlining the purpose of addressing and the management of address data:

- (2) Road names and addresses are assigned with regard to helping citizens, authorities, utilities, emergency response services and others to orient themselves and to locate the road, property, building, main entrance, dwelling or business entity etc. in question in the easiest possible way. (…)
- (3) The registration of the designated road names and addresses has as its purpose to ensure that correct information on the subject may be available in a uniform way to citizens, the business community and the public administration.

Note that the addressing system is first and foremost defined as a spatial reference system, which should enable safe "navigation" in the real world. The definition underlines the multipurpose aspect of addressing and does not prioritize postal services or an administrative "government" perspective. Note also that the purpose of address data registration is to make the data available as a common reference in a uniform way (i.e. in a standardized format) for citizens and private and public users.

Improved addressing and address data

Since 1996, based on the common understanding of the value of a well-formed addressing system, the government and municipalities have cooperated towards harmonization and quality control of the addresses in the public registers and maps. This cooperation focused on collecting the official set of "reference" addresses that should make up the address file in the base **address register**, according to the conceptual approach described above. This cooperation should particularly emphasize:

- The establishment of the BBR as the base address register, containing the reference set of addresses (like a master address file);
- The attachment of an "address point" location to all addresses, based on a set of geographic coordinates that pinpoint the "front door location" of each address.

The outcome of this address project was that, between 1996 and 2001, all municipalities voluntarily updated the BBR with the requested precise address points. As a result, the BBR now contains 2.4 million individual addresses, 99.8% of which are located by an address point. For more than 98% of address points, positional accuracy is better than +/- 5 metres. The modernized BBR system, including the base address register, was deployed in December 2009. The system was created on a single relational database with a simple Internet interface, used by all 98 Danish municipalities. As the BBR system also offers a generic web

service interface, it is possible for IT developers to create more sophisticated or specialized BBR management, for example, to embed address management in a map-based web application or in a standard geographic information system (GIS).

Post Denmark's services are also based on official street names and house numbers assigned by the Danish municipalities, with the exception of specialized postal delivery points, such as poste restante and P.O. box addresses, and special company postcodes reserved for large organizations.

In 2004, after the introduction of the address regulation DECA invited the most important address stakeholders and address data users, such as Post Denmark, the national police, the "112" emergency centres, fire departments and a private ambulance service, to discuss **key challenges and problems in addressing**. The biggest problem highlighted was that of ambiguous road names within a postcode. It was found that a road name could occur two to five times within a postcode. Circumventing this problem meant adding the name of the village or neighbourhood in an extra address line. As the problem affected only a small fraction of all road name addresses, this solution was not well known and was difficult to implement in IT applications.

DECA, Post Denmark, and the National Survey and Cadastre formed a task force to consider the problem. The task force found that approximately 1% of all addresses were affected, which translated into 1,000 road names, 20,000 households and 5,000 businesses. A telephone survey verified that, for the people affected, the problem caused daily irritation and trouble in the delivery of post or goods, and, most importantly, was a persistent cause of anxiety in the case of an emergency. The task force drafted a solution to change the name of more than 500 roads, introduce five new postcodes, and adjust boundaries between some existing postcodes.

In 2008, DECA commissioned an analysis to compare the annual cost to society of ambiguous road names with the cost of implementing the solution. The analysis showed a gain for society in the short term and DECA, Post Denmark and the Danish municipalities agreed to proceed. In late 2008, DECA issued the "Statutory Order on Unambiguousness of Road Names", which included a list of all conflicting road names in an annex. Under the order, each municipality had to decide which road names should be changed and what the new names would be. After an admirable effort carried out by the municipalities and Post Denmark, the work was finalized in 2010. As a result, the Danish address now comprises three elements that are always unambiguous: road name, house number and postcode. In view of the fact that changing someone's road name is a sensitive matter, it was interesting to note that very few citizens or businesses complained about the decisions taken by the municipalities. Citizens apparently accepted the good reasons for the change.

The process of changing duplicated road names demonstrated the value of formally regulating the addressing system, and emphasized the importance of identifying the appropriate authority and its responsibility to assign and change road names, house numbers and postcodes. Had the legislative addressing framework not been developed in 2001, this improvement in addressing and address data could not have been attained.

Benefits for society

The municipality address project (1996–2001) raised interest among major nationwide users even before its finalization, particularly regarding use of the harmonized address data. Many public sector users, including the county administrations, the Department of Environment, the Department of Agriculture and Food, the Department of Health, Statistics Denmark, and, perhaps more importantly, the police and emergency services, argued that wide access to the geo-referenced address data would reap substantial benefits (Lind, 2003). The requirements and interests of the private sector were even greater. As a consequence of the wide use of inaccurate information in private address data products, there was a high demand within the private sector for reliable, updated and accurate official reference data, especially if it could be obtained with conditions that allowed for further development and value adding.

In 2002, after several years of negotiation between the Danish E-government Taskforce, the Danish Ministry of Finance and the Local Government Denmark (the organization of municipalities), an agreement was reached entitled "Better Access to Public Data". One of the most important elements of the agreement was that, from 1 January 2003, public address data in the BBR, including address point data, would be made available to all sector users at a minimal delivery cost. The agreement also stated that any party was free to develop new value-added products, applications or services for further distribution, without paying a fee for the original reference data and without licence or copyright restrictions. However, the agreement did not cover topographic map or cadastre data from the National Survey and Cadastre.

The **data pricing agreement** was based on three principles:

- **Mutual benefit**. All parties, including the private sector, should be able to obtain concrete benefits from the agreement.
- **Minimal impact on budget**. The loss of potential income from data sales and the extra workload involved in the mandatory updating of data by municipalities would be compensated by approximately 2 million USD over four years.
- **High impact in private sector and private–public benefits in terms of profit and interoperability.** The availability of low-cost and high-quality address data would kick-start the development of location-based services and a broad range of address-based interoperable e-government applications.

In 2005, a draft survey carried out by the National Survey and Cadastre on the impact of the agreement showed that, in addition to general satisfaction, the address data had already been integrated into several national applications. These included: the "112" emergency centres, public transport companies' Internet-based journey planner and several GPS navigation products. This was due to dramatically reduced costs of acquisition and the ability to share and use address data commercially without a licence.

In early 2010, DECA commissioned a more in-depth study (DECA, 2010) on the benefits associated with the 2002 free-of-charge address data agreement. The study, completed for DECA by a private consultant,

was mainly based on information from the 22 "data distributors" that disseminated address data from the BBR. The study included only the direct financial benefits for more than 1,200 parties (third level of the data distribution chain) who received address data from a second-level data distributor. Therefore, it did not assess the additional economic benefits beyond the third level of the data distribution chain, presumably of considerable size. One example of an additional economic benefit is the almost systematic use of addresses in GPS systems. According to 2010 Statistics Denmark data, 1.3 million Danish families possessed a GPS navigation system potentially containing an official address dataset.

The study estimated the direct financial benefit for the period 2005–09 at around 90 million USD (approximately 471 million DKK). The total cost of the agreement was only about 3 million USD. Furthermore, approximately 30% of the benefits were located in the public sector and 70% in the private sector. The study concluded that the total social benefits would be about 20 million USD, while the cost was only 0.3 million USD – an extensive return on investment of 70 to 1. The study offered evidence on the considerable socio-economic benefits of the free-of-charge agreement, obtained through the reuse of address data as a common asset.

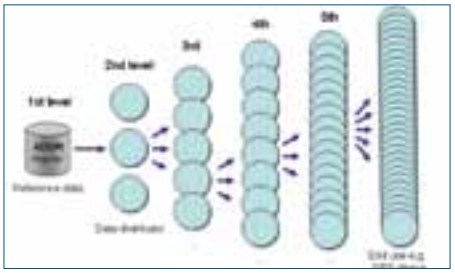


Figure 4. Modelling the address as an attribute or as individual entity type

The study also indicated that not all expected benefits have been achieved yet. For example, among public business registers, customer databases and utilities, the use of official addresses as a common reference is limited. According to Statistics Denmark, enterprises and institutions that employ about 15% of the Danish workforce use invalid addresses, namely, ones not officially recorded in the base register. The study also demonstrated that DECA and the municipalities will still face addressing challenges in the years to come, and that significant socio-economic benefits could be obtained. Another future challenge includes making data from the base BBR available in the near future through the "address a service" technology (i.e. through reliable and high-performance web services), so as to avoid problems associated with the continual updating and synchronization of local address databases.

Conclusion

During the last 15 years of address management in Denmark, the most important lesson learned has been the recognition of the addressing system as a common asset for Danish infrastructure.

At the same time, and as a result of society's digitalization, address data has been acknowledged as an important and very valuable common reference dataset in digital infrastructure for e-government, public services, local communities and volunteer organizations, as well as for private sector business and innovation. In the light of the Danish experience, a number of additional lessons can be identified:

- The addressing system should be transparent and homogeneous; it should be governed under democratic control and acknowledged as a common asset for society. This is the best way to achieve consensus and awareness on the mutual benefits for citizens, business and government.
- The roles and responsibilities of maintaining and supporting the addressing system, as well as the responsibility of address data management, should be clearly defined, if possible by law. Unclear responsibility results in poor addressing, duplication of work and lack of data integrity.
- Addresses and address data should be unambiguous and should be maintained and updated. This will prevent unnecessary costs and errors that could have serious consequences to lives, health or property.
- Addresses and address data should be standardized and well formed in order to enable efficient business processes and provide the best possible competition between different IT application vendors. Without a standard, the use of addresses and address data is uncertain, inefficient and costly.
- Address data should be available for all users with as few barriers as possible. If this is not the case, the use of addresses as a common reference will not yield the otherwise significant benefits.

The general lesson is that public investment in a strong and homogeneous addressing system is minimal when compared with the volume of socio-economic benefits gained. However, there are no easy results, and though the journey has been long, it has not reached its end. There are still important improvements to make, errors to correct, problems to solve and challenges to meet – but also more benefits to gain.

1) The term "road" is used instead of "street" to refer to all thoroughfares. The term implies a broader concept, whereas "street" may be associated with urban areas.
2) The term "house number" (instead of "address number") is used in this study for the purposes of consistency with the rest of the publication. However, it is important to note that, in some countries, an address number is not the number of the house (i.e. building), but rather a numbering of entrances to the building. If the building/house has two main entrances, it has two independent house numbers.
3) For more details, see: www.adresse-info.dk
4) The term "base" is used here to identify a database designated as the official "reference", "authentic" or "authoritative" register of addresses, persons, business entities, etc.

Busan, Korea

Case study: Republic of Korea

Korea's new addressing system

Ministry of Public Administration and Security (MOPAS)

The jibeon system

Until recently, the Republic of Korea (Korea) has used land parcel numbers (**jibeon**) to identify unique locations. This system was initially used to identify land for census purposes and to levy taxes. In addition, until the launch of the new addressing system, the **jibeon** was also used to identify locations (i.e. a physical address). These parcel numbers were assigned chronologically according to date of construction and without reference to the street where they were located. This meant that adjacent buildings did not necessarily follow a sequential numbering system.

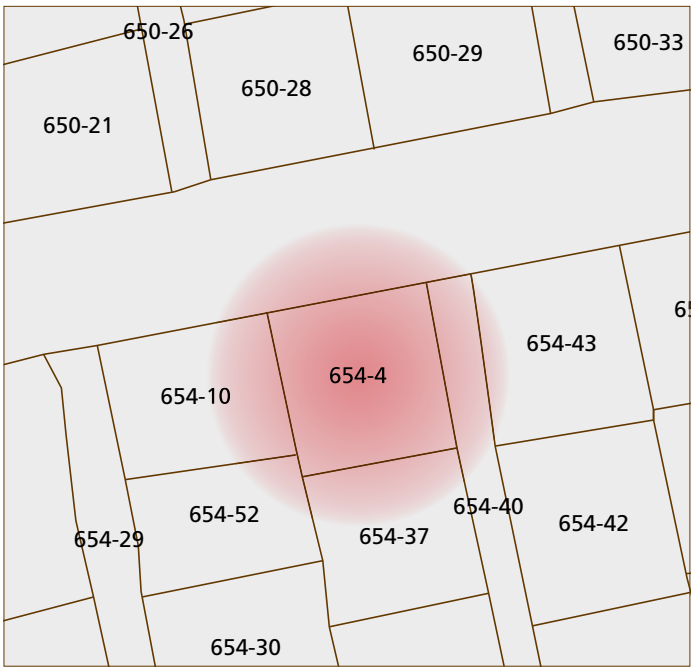
At first, the amount of parcels remained low and the use of land parcel numbers for addresses was easily manageable. After 1960, however, Korea's rapid economic development and population growth witnessed the expansion of urban areas. This caused diversification of land use and resulted in the continuous partition and annexation of lands. As a consequence, discontinuity in parcel numbering increased and the lack of an apparent relationship between land parcel numbers and actual address location made finding a specific building a challenge.

The new addressing project

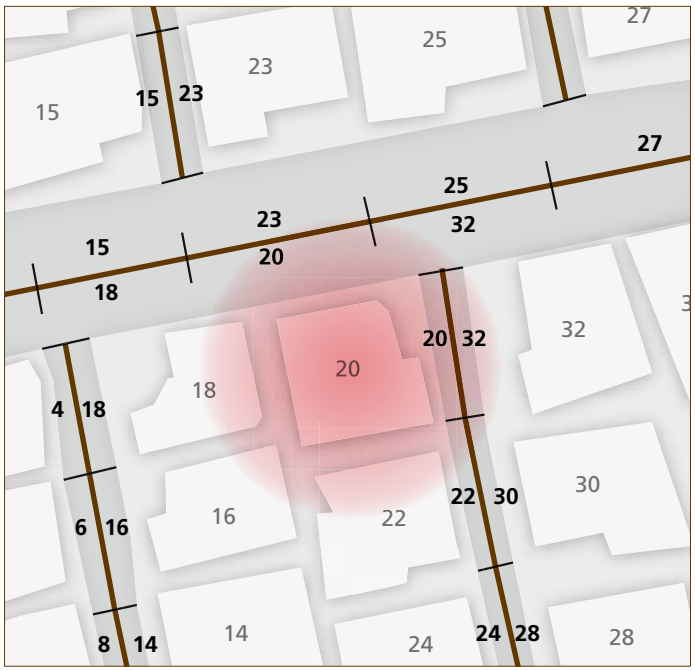
The confusion caused by the traditional **jibeon** system and its inability to meet the challenges of a modern Korean society, including rapid urbanization, economic needs and the desire to capitalize on Korea's IT society, provoked a government-led shift towards a new addressing system based on road names and building numbers.

The new addressing system represented an opportunity to resolve various social and economic challenges plaguing Korean society, such as barriers to free movement and communication, the slow response time of emergency services and high distribution costs. Furthermore, a new addressing system constituted a means to improve public administration and facilitate tourism.

In 1996 and 1997, two projects for assigning street names were implemented, with a view towards understanding the possible benefits of a new addressing system for national development[1]. In 1997, a new law transforming the Korean addressing system came into effect, facilitating the process of street name assignation and signage in six cities, counties and districts (including Kangnam-gu, Anyang, from 1997 and 1998). Following the positive outcomes of these projects, the government enacted the "Road Name Address Act", and on 5 April 2007 initiated the reorganization of the



Present address according to the address system based on land-lot numbers



Street name address according to the address system based on street names

country's addressing system. The project, entitled "Road Name Address", aimed to achieve implementation of the new addressing system in 230 self-governing bodies nationwide.

The new addressing system of the Republic of Korea discarded the old **jibeon** system and replaced it with a format based upon a road name and building number. The system consists of: city or province (Si or Do),[2] district or smaller city (Gu or Si·Gun),[3] town (Eup·Myeon)[4] + road name + building number + "dong·cheung·ho" (refers to the previous system for location addresses). Currently, these elements are all mandatory.

The Ministry of Public Administration and Security (MOPAS) introduced the new system on 29 July 2011. MOPAS was charged with establishing national addressing policies and implementing the new road name addressing system in cooperation with central and local governments, who aided in the development and promotion of the project. Local governments, in particular, were responsible for granting road names and building numbers, as well as affixing road and building signage.

Other public agencies also played a role in the project with individual agencies responsible for revising addresses found in various records and books. This necessitated the creation of task forces operated by the respective public institutions. For example, Korea Post was charged with matching the new addresses with postal numbers, and organized a task force to use the new addressing system to train postmen to improve collection and delivery. The National Emergency Management Agency and the National Police Agency also revised address data to ensure prompt service in emergency rescue efforts. The private sector was also integrated into the project through a working group, which among other activities contributed to localizing each business area.

Project phases

To reduce inconvenience to its citizens, the government of Korea established a five-phase progressive project strategy to implement the new system.

The **first phase**, the "road name assigning" period, took place between 1996 and 2006. The results of the two pilot projects and case studies were used as the basis for standardizing addresses countrywide. The main body of work then involved setting road sections and assigning road names. A consultation process on street naming was launched, which took into account customs, history and regional characteristics, as well as public and expert opinion. Local governments, cities, counties or district offices in charge of paving and naming the selected roads areas, were charged with managing the new address information. Administrative procedures and forms, such as building permit applications, were also adapted in cooperation with the relevant departments so as to incorporate location information in real time.[5]

The **second phase**, the "facility project" period, took place between 2007 and 2009. Tasks set for this phase included the creation of digital maps based on the new road name address information, the assignment of building numbers and the installation of road and building signage.

The **third phase**, the "address conversion" period, took place from 2010 to 2011. During this time addresses recorded in public documents were updated with the new addresses. Throughout this period, citizens and businesses were personally informed of the newly assigned addresses. Businesses were strongly encouraged to use the new addresses on their signage and on promotional and marketing materials.

The **fourth phase**, the "coexistence" period, is currently underway and is set to end in 2013. During this period, the **jibeon** address and the new road name address, may be used together on any legal document.

The **fifth** and **final** phase, the "exclusive usage" period, begins in 2014. From this point onwards, only use of the new road name

Seoul, Korea

address is permissible. This stage will also see the establishment of a one-stop guide service system to connect the nationwide addressing system with the IT network.

Assignment scheme

Under the new system **road names** were designated either as 'Daero', 'Ro' or 'Gil' depending on the size of the road. Daero is used for a wide road (more than eight lanes), Ro indicates a medium-sized road (two to seven lanes) and Gil denotes a narrow road. A building number is assigned based on the road name and the basic road number, depending on which road is closest to the building's main entrance. Road segments were divided and serial numbers assigned theoretically before testing the assignation through field surveys. Basic distance intervals were set 20 metres apart in a symmetrical way. After that, buildings were numbered sequentially, beginning with an odd number if a building was located on the left side of the road and an even number if it was on the right.

The new addressing system enables delivery points to be verified, using both the street name and building number, as well as the detailed address (dong, cheung, ho) marked on the letter box. This results in a very low level of confusion when delivering services or sending items.

Challenges

The main challenges to implementation of the road name address project involved low public awareness and consequently low public participation in the new addressing system. Over the course of the project, efforts have been undertaken to remedy these challenges.

In response to **low public participation**, information sessions were held in each city and village to inform residents of the problems caused by the jibeon system and the benefits of the new system. To encourage residents to take ownership of the project, they were invited to participate in the selection of road names. They were also consulted on ways to monitor the street name changes with a view to avoiding resistance and encouraging acceptance during the implementation phase.

To offset **low awareness**, a continuous publicity campaign was launched via broadcast media, including TV, radio and Internet, as well as the use of outdoor billboards to disseminate public information on the project. Newspaper articles by opinion leaders among others, and various experimental events were also used to prompt people to use the new system.

Due to these governmental campaigns, public awareness of and participation in the new addressing system have remarkably increased. Continuous efforts will be needed down the road to ensure that all Koreans participate in the new system. [6)]

Benefits

The new addressing system is expected to bring numerous social, economic and political benefits to Korean society, key among them being improvement the delivery of services. Moreover, by making navigation of the physical space more user-friendly, the new road name address will enable Korean residents and foreigners to more conveniently find correct and accurate addresses, help to reduce traffic congestion in cities, and improve the national image. Most importantly, accurate location information will protect people and their assets by shortening the time it takes to reach a location in the event of an emergency or disaster.

Korea's **IT capacity** will also benefit from the new addressing system, in particular, mobile navigation, Location Based Services (LBS), telemetrics, and so on. It will also contribute to the creation of a "Ubiquitous City", whereby inhabitants may obtain information and establish communication with any person, anywhere

and anytime by combining IT information with 'location information'.[7] The maintenance of a database of new road addresses will enable real-time, updated location information to be provided to the ubiquitous service developer and the people virtually free, contributing to a convenient and competitive service technology. This technology will ensure the efficient and safe flow of information and service delivery, and the technological integration of all regions will help to bridge the divide between urban and rural areas.

At the national level, the new road name addressing system will contribute to improving **national infrastructure and public administration**. The new scheme is necessary to enable local governments to efficiently undertake administrative procedures and to exchange information with MOPAS. In addition, the project has proven essential for the Ministry of Land, Transport and Maritime which is responsible for the national transportation database and for the management of a geographical information system for collection and delivery; the National Police Agency, who can use the system to create a base map to manage crime information; the National Emergency Management Agency, responsible for the national safety system; and the National Statistical Office.

Other sectors such as **logistics** and **e-government** also derive indirect benefits from the road name addressing system. Clear and accurate addresses are an essential foundation for facilitating delivery of services. As the Korean Institute of Public Administration has reported, reducing national distribution expenses can help establish Korea as a distribution hub in Northeast Asia and further boost its economic development. The system will also help to broaden e-government development. At present, Korea's e-government is one of the most advanced in the world. By linking the location information of various public agencies, the e-government system can improve the quality of public services, facilitate the exchange of public information and prevent overlapping investment. For example, currently more than 69 cities, counties and districts use a location-search guide service on their Internet homepages.

The **private sector** can also benefit from an improved addressing system. This is particularly true of businesses that need location-based information to deliver services or identify or reach their clients. Reducing location-search costs, in terms of both time and money, strengthens the competitiveness of the distribution industry. The new addressing system is particularly beneficial for creating a guide map for door-to-door delivery systems, real estate or go-between agencies, which together account for more than 38,000 enterprises. Other uses could include the verification of old addresses against new ones to ensure delivery of payment notices for credit card companies (e.g. this has been done for a total of 50,000 cases in the case of the LG card).

Conclusion

Changing the addressing system is not an easy task; it means modifying a major state infrastructure, which requires commitment, resources and time. It is important to note that the structure cannot be modified at once and necessitates planning. The Korean Government has continuously undertaken address-revision efforts since 1948 leading up to the current road name addressing system.

Strong governmental commitment is crucial. Frequent policy changes in either mid-term or long-term policies amount to important additional costs and may result in distrust or confusion among the general public. A thorough command of the different phases of the project is directly linked to its credibility and its success.

The success of such a structural project depends upon the broad and deep cooperation of different interested parties. Stakeholders cannot be ignored and different sectors should establish and coordinate a nationwide schedule for implementation, including updated and consistent information and a time frame.

This project has shown that the public believes an addressing system must reflect the customs, history and regional characteristics of a country, and that continuity is an essential factor that must be considered. Public opinion should be incorporated into addressing policies from start to finish. It is important to develop programmes that stimulate public involvement in the project, rather than undertaking publicity campaigns to persuade the public of its merits at a later stage.

As a result of its experience, Korea is ready to help and support other countries facing similar challenges and contemplating improvement of their addressing system. The Government of Korea plans to share details of the new addressing system. In the meantime, details can be retrieved from the official New Address Information website.[8]

1) For more details, see: http://www.juso.go.kr/eng/about/ProjectStatusandProgress.htm
2) Si (city) refers to a regional administrative district with a local government covering 50,000 or more people. Do (province) refers to a metropolitan government under the direct jurisdiction of government.
3) Si (city), Gun (county) and Gu (district) have local governments under a provision of Article 2 of the Local Autonomy Act of Korea. Gun is an administrative local government zone under the level of province and above the level of Eup and Myeon. Gu is an administrative district smaller than Seoul Metropolitan City and other metropolitan cities, as well as cities with a population of 500,000 residents. It has responsibility for its affairs delegated by the state as a general administrative agency.
4) Eup and Myeon are lower administrative districts of the Gun (county). Eup is defined as a place of mostly urban appearance with a population of 20,000 or more. Eup has more service and administrative capability compared to Myeon, which has a less urban character.
5) http://www.juso.go.kr/eng/about/ProjectJustification.htm
6) http://www.juso.go.kr/eng/about/ProjectJustification.htm
7) http://www.juso.go.kr/eng/about/ProjectJustification.htm
8) For details, see: at: www.juso.go.kr/openEngPage.do

Case study: Costa Rica

San Jose, Costa Rica

Addressing and signage in Costa Rica

Correos de Costa Rica

In the past, classic physical addresses composed of a street name and house number barely existed in Costa Rica. Most Costa Ricans used descriptive addresses to locate a place, resulting in an idiosyncratic and at times folkloric way of referring to location. Where street names and property identification did exist, as in the provincial capitals, those names were inspired by the cultural origins of inhabitants, but were not often used. Through the disuse of proper address names and the gradual deterioration of existing identifiers, addresses became almost obsolete.

The negative effects of this absence of a sound physical addressing system and proper signage were far-reaching, resulting in high costs for citizens, public organizations, businesses and tourists, and seriously hindering the national economy in general. In lieu of a national labelled urban road network, geographic points in cities (addresses) were located through reference points, cardinal directions and estimates of distance in metres or steps. A preliminary study estimated annual losses of 720 million USD for the country's economy and showed that poor addressing adversely affected society in a number of ways. Public and private organizations, for example, were impeded from offering the best service, with repercussions on the economy and society as a whole. Legal authorities had difficulty locating people, the tourism industry suffered and drivers could not use GPS technology because the existing addressing system was not linked to global software. Furthermore, no digital database of national addresses existed for use in geographic information systems. The study concluded that there was a lack of real physical data for administrators, investors and tourists.

The postal sector was also affected: customers were dissatisfied with the high volumes of returned items and the Post had lost credibility. According to a study conducted by Correos de Costa Rica, 40% of the addresses in the databases of Correos' corporate clients were incorrect. From an operational point of view, addresses based on reference points and distance in metres impeded delivery. For example, only 20% of the total mail to be delivered daily in San José's greater metropolitan area arrived at the intended destination, and this was largely due to the personal knowledge of the mailperson. This situation made the use of technology impossible, and so all internal and external operational processes were implemented manually, resulting in high administrative and operational costs.

The challenge

The only solution was the development of a national addressing project including the

implementation of technical standards, street signage, plot identification and postcodes. In 2003, Correos took the lead in the process supported by an inter-institutional committee, the UPU and an external expert.

Technical standards

Disorderly urban plot identification and a lack of standards regulating the establishment of new constructions and routes proved major impediments to the design of a national addressing system. Quadrants existed only in the urban downtown and irregular street layouts were the norm everywhere else. For this reason, Correos started establishing criteria to identify the exact location of all buildings throughout the national territory, and for assigning an address to each of those physical spaces.

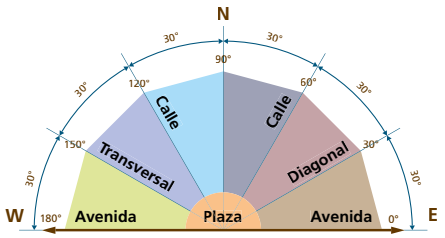


Figure 1. Route definition based on a east-west axis

he first step was to define the types of routes and the technical concepts to be used in the national standard. This standard would include the criteria for naming streets, numbering routes and identifying individual distribution points. Six route types were established: avenue, street, diagonal, transversal, plaza and road. Routes were designated according to their degree of inclination with respect to the east-west axis. Next, streets were numbered in reference to a central axis (odd avenues on the north side and even avenues on the south side; even streets on the west side and odd streets on the east side). These efforts gave rise to a new technical standard for the identification of addresses, published in December 2005.

The technical standard respected the existing numbering of identified streets, provided that there were no contradictions with the standard. It also allowed for the coexistence of both systems of identification – the new number-based system and the old one, which used street names – thus making it possible to retain the cultural identity associated with street names.

In addition, Correos undertook a consultative process with a view to defining an address structure that placed the components in a specific sequence.

1. Name of addressee	Doris Vásquez Solano	1st line
2. Identifiers, reference point and distance	200 m north of the US Embassy	2nd and 3rd lines
3. Geopolitical information	San José, San José, Pavas	4th line
4. Postcode	10109	5th line

Figure 2: Address Standard

Street signage and plot identification

The new technical standard served no purpose unless there was a corresponding system of street name signage and plot identification. Without this, the technical standard was merely a series of logical rules bearing no relation to the everyday lives of the country's inhabitants.

In this context, a multidisciplinary committee was created to assess the problems the country faced as a result of the inadequate system of street and plot signage. In 2007, the national land register published a study on the national land registry project, which determined that the country had virtually no street signs in urban areas, and that those that did exist had been defaced, were obsolete or lacked a standard.

It was decided, first of all, that a geometrically corrected (orthorectified) map of the country needed to be produced, to serve as the basis for identification of the road network. The technical standard was applied to assign addresses within the road network. Next, the fieldwork was planned and carried out using GPS equipment and metric measuring wheels (pedometers). Buildings and vacant lots were geo-referenced and the information gathered was stored in a geographic information system. Variables recorded during the fieldwork included: primary street, secondary street, distance in metres, number of floors, building number, building height, door number (standardized address) and activity carried out by the inhabitant. Once revised, this information was uploaded to specialized software.

On the basis of the new street network plan, local governments and municipal authorities could begin the street signage phase. To help municipal authorities with this task, Correos drafted a technical paper on vertical signage. The paper sought to find a solution based on a Central American transit control manual (Manual Centroamericano de Dispositivos Uniformes para el Control del Tránsito), which included references to plot identification and geo-referenced signs. As a result, a digital street network and urban street signage project was established to serve as the basis for the erection of signs in Costa Rica's main towns, cities and urban areas. Municipal authorities were charged with this task, as well as with that of promoting standardized signage throughout the nation and keeping it free from visual contamination. It is important to note that signage is the responsibility of local authorities, but has to reflect the decisions and wishes of the residents or owners of the property.

Figure 3: Example of standadized signage

In addition, a national system of territorial information was created based on geographical information, including addresses. This open and transparent system was designed to grant access to information, including universal access to spatial data, and to allow a high degree of interoperability with other data systems. These activities were financed through an agreement between the government and the Inter-American Development Bank.

Limón, Costa Rica

Postcode system

In addition to signage and the technical standard, a national postcode system was designed, allowing identification to the level of a dwelling's door. The system made it possible to number and identify every building and street in the road network – a practical tool for addressing. The system was based on the country's administrative divisions (provinces, cantons and districts) and the government's official numbering of those divisions. Each district was assigned a postcode at the national level.

One of the aims of the postcode system was to facilitate mail segmentation, sorting and distribution, in order to shorten delivery times and reduce addressing errors. Moreover, based on the five-digit postcode, Correos developed a 19-digit code, for internal use only, to identify each delivery point. Correos also sought to improve the quality of information in its customer databases and to examine the possibility of integrating them with other databases.

Project implementation

In the five years following implementation of the technical standard for address identification, Correos de Costa Rica mapped or georeferenced around 432,000 points (out of a total of approximately a million) by using GPS and pedometers. The points were assigned a standardized address, accompanied by the corresponding personal data. The work was mostly carried out in the greater metropolitan area, where about 75% of the country's socioeconomic activity is concentrated.

Meanwhile, over a period of two years, the municipality of San José identified and developed signage for plots in the 11 districts of the central canton of San José. At the same time, districts in other cantons were able to carry out street signage work with the support of the European Union through a municipal enhancement and decentralization project (FOMUDE), completed at the end of 2010. Since then, more local governments have shown an interest in starting the process of assigning street names to the road network.

In addition to street naming and signage, plot identification was coordinated and implemented by government authorities at various levels, in order to ensure the successful completion of the addressing project countrywide.

Finally, an awareness-raising campaign was launched in conjunction with the cantonal authorities (public and private bodies) to demonstrate the consequences of the lack of an addressing system, to guarantee the correct use of addresses, and to ensure the system's sustainability.

In terms of overall project costs, it was decided that Correos would lead the project in order to keep costs down (at 2.61 USD per address). The highest expenses were related to the production and installation of physical street signage, as these activities were undertaken by external providers (see Figure 4).

Benefits

The above-mentioned costs represent a massive investment in the country's infrastructure for a project achievable only in the medium and long term. Despite these constraints, all the stakeholders in Costa Rica are convinced that a standardized and stable system for addressing and signage provides social, political and economic benefits. The implementation of a sound addressing system in Costa Rica allows urban space to be restructured according to clear strategic planning objectives, producing equitable conditions for the use and enjoyment of that space. The new system also makes Costa Rica's cities more accessible for citizens, thus enhancing their sense of belonging and identity. It contributes to increased productivity in both the public and private sector, bringing important benefits to the national tourism industry and helping to reduce Costa Rica's ecological footprint.

Major benefits since project implementation:

Emergency services. The new system makes it easy to locate addresses. In the case of an

Activity/goal	Responsible Party	Cost (USD)
Publication of an executive order	Office of the President, Programme for the Regularization of the Land and Real Estate Registers and Correos	2,000
Creation of trust fund	Programme for the Regularization of the Land and Real Estate Registers and Correos	30,000
Development of road network and digital address database	Programme for the Regularization of the Land and Real Estate Registers and Correos	100,000
Erection of signage on public urban road network throughout national territory	Contractor(s)	4,825,000
Communication	Contractor	180,000
Training	Contractor	1,000,000
Website	Contractor	10,000
Formation of project implementation unit	Programme for the Regularization of the Land and Real Estate Registers and Correos	185,000
Total		6,332,000

Figure 4: Estimated Costs of the addressing project

emergency, clear and accurate address information is vital for saving lives, fighting fires or ensuring a rapid security response.

Statistics. Accurate information on identity and location, for both people and places, makes it possible to save time and money in the costly statistical work carried out by public administrations. A clear addressing system also benefits other organizations whose work requires an accurate and up-to-date directory of streets.

Urban planning and zoning. Street signs help individuals to understand and navigate the urban space. Furthermore, a countrywide street nomenclature makes it easier to organize urban growth according to clear strategic planning objectives, and to take into account different development needs, including those of spontaneous habitats.

National registers. The National Register of Real Estate uses street nomenclature to describe the precise location of a property. Its records include an address field that follows the specifications of the technical standard. Other bodies that register land and monitor tax activity also use this information.

Tourism. One of the industries most affected by the absence of street addressing was tourism. Previously, areas without signs created confusion for both Costa Rican and foreign tourists. Now, better street name signage enables people and goods to move freely throughout the country.

Postal service. This sector received the most direct, immediate and visible benefits from the new addressing system. Previously, the postal service could not properly deliver correspondence, bills and public notices to their destination. Without adequate standards, mail shipments had to be classified manually, increasing costs and hindering productivity. Addressing and signage have helped to improve communication among inhabitants, and allow the postal service to operate more effectively.

Private sector. Street signage enables private sector companies to optimize their logistical operations and market sectorization, for greater efficiency and lower distribution costs. This is especially true for companies whose business involves product distribution, since they need to be able to calculate distances accurately.

General public. Finally, the general public benefits the most from an organized system for identifying and locating streets and buildings. Whether for work or for leisure, individuals need a clear, comprehensive network of street signs and addresses to undertake their daily activities.

Conclusion

Correos de Costa Rica realized that addresses lay the centre of the postal business. The development and prosperity of the Post hinged on the existence of up-to-date, accurate and unique addresses. Given the nature of its activities, Correos was best suited to carry out the addressing project. However, the commitment of the Government was crucial to the project's success. Acting on the mandate of the President's Office, Correos joined forces with other public institutions to make the national addressing system a reality. The project could not have been implemented without the support provided by various levels of government, the efforts of stakeholders, and the positive response of Costa Ricans.

The development of the new addressing system has, without a doubt, led to improved postal operations. More importantly, it has solved many of the organizational challenges experienced across the country, and has contributed to more equitable development in Costa Rica's urban and rural areas, as well as in the tourism sector – a vital component of the national economy.

Correos de Costa Rica hopes that its system can serve as a model for other countries working to develop their own national addressing projects.

Case study: India

The Aadhaar number: a unique ID project

Pushkar, India

In India, proving one's identity is a constant challenge, particularly for the poor. Many individuals lack basic documents that establish their identity such as a birth certificate or a proof of address. Instead, local authorities often verify personal information, a form of recognition that often does not transcend the boundaries of the village or state. Without a universally accepted proof of identity residents experience administrative barriers to accessing public and private goods and services, and encounter difficulties when migrating from one state to another (Polgreen, 2011).

In response to these challenges the Government of India has embarked on a nationwide Unique Identification (Unique ID) project. The project was created with the purpose of providing individuals with a universal identification number that would facilitate their access to public and private services. By strengthening the relationship between welfare beneficiaries and the government, the project seeks to improve the efficiency and efficacy of public programmes. The project's other objectives include countering illegal immigration and terrorism.

The organization charged with governing the project is the Unique Identification Authority of India (UIDAI), which is tasked with providing India's more than 1.2 billion residents with a standardized 12 digit number or "identity", called an Aadhaar number. The number will be randomly generated without any classification based on caste, creed, religion or geography. The Aadhaar number verifies an individual's personal information such as their name, birthdate and address, as well as their biometrics (fingerprints and iris scan), and is accepted at any agency, everywhere in India.

Within the scope of the project, the new identity number and corresponding personal information is stored in a centralized database and can be verified online quickly. Agencies seeking to confirm an individual's identity can enter his or her Aadhaar number in the UIDAI's online database and within seconds receive a positive or negative answer. This system is cost-effective and robust enough to eliminate duplicate and fake identities and will serve to improve the delivery of public services and the effective monitoring of government programmes.

Project beginning

The concept behind the unique identification project began as part of the "Unique ID for Below Poverty Line (BPL) families", created and approved in 2006 by the Department of Information Technology within the Ministry of Communications and Information Technology. Subsequently, a decision was taken to create the Unique Identification Authority of India

New Delhi, India

(UIDAI) by executive order under India's Planning Commission, in order to ensure a pan-departmental and neutral identity for the responsible organization. In 2009, the new government agency was created and was given responsibility for laying down plans and policies to implement the unique identification scheme. Once in place, the UIDAI would also instruct other agencies creating databases on the standardization of data elements, so as to ensure their compatibility with the Unique ID database.

Implementing actors

The UIDAI is responsible for the project and will own and operate the Unique ID database. Its headquarters are established in Delhi and eight other regional offices are located throughout India in Chandigarh, Delhi, Lucknow, Ranchi, Guwahati, Mumbai, Hyderabad and Bangalore.

The UIDAI authorizes "Registrars" to conduct the enrolment of individuals for Aadhaar numbers. In this regard, project implementation requires the participation of many different actors. Typically, Registrars include national government departments, public sector organizations and other agencies that interact with residents as part of their normal activities, including private sector organizations. Examples of Registrars include India Post, the Rural Development Department, the Civil Supplies and Consumer Affairs Department, insurance companies and banks. About 60 Registrars have entered into a Memorandum of Understanding (MoU) with the UIDAI to enrol individuals. The Registrar is responsible for ensuring that the Aadhaar number enrolment process is inclusive and that the data collected is correct and follows processes and protocols prescribed by the UIDAI. Once the Registrar has enrolled the individual, the data will be verified centrally by the UIDAI and an Aadhaar number will be generated and sent to the individual's address. The full list of Registrars is available on the UIDAI website.[1)]

By removing duplicates from their databases upon enrolment of individuals, it is believed that Registrars can improve their organization's efficiency and lower costs. For example, Registrars focused on social goals will find that a reliable identification number will help them to broaden their reach to groups that, until now, have been difficult to authenticate. Other Registrars will experience significant cost-savings, including Know Your Customer (KYC) costs, as a result of the UIDAI's verification processes.[2)]

As part of the implementing process, the Department of Posts has agreed to play a supportive role. In April 2010, an initial MoU was signed between India Post and UIDAI. This MoU allows UIDAI to use Media Post and Direct Mail services to promote the Aadhaar number to targeted groups of residents across the country. In September, a second MoU was signed identifying India Post as a Registrar and identifying post offices as Aadhaar number enrolment stations (India Post, 2011). It was believed that the vast network of post offices would enable the Department of Posts to play a key role in this project (UNFPE, 2011).

The unique ID project differs from the National Population Register (NPR), undertaken by the Home Ministry, which will enumerate persons living in a particular demarcated area and will issue each individual with a national identity card. The NPR is an important Registrar in the Aadharr numbers enrolment process and the authenticated data collected by the NPR will be sent to the UIDAI for data deduplication and issuance of the Aadhaar number (DIT, n.d.).

It is expected that other existing identity databases (voter ID, passports, ration cards, licenses, fishing permits, border area ID cards) will be linked to the Unique ID database. Among others, the National Rural Employment Guarantee Scheme (NREGS), which legally guarantees employment for 100 days per household, is expected to integrate with the Aadhaar number. This will help expand the programme's reach and increase transparency at various levels by making an Aadhaar number a prerequisite for participation in the programme (Dass, 2011).

Challenges and solutions

To apply for the Aadhaar number individuals are required to provide the following information: name, date of birth, gender, address, parent/guardian details (required for children, voluntary for adults), phone and email (optional), a photograph, 10 fingerprints and an iris scan. Acceptable proofs of identity range from passports to ration cards to address cards issued by India Post, among others.

One challenge encountered throughout the project was collecting adequate proof of identity to supply the Aadhaar number. Although the Aadhaar number is created "for every resident, irrespective of existing documentation"[3)], and will serve as a future proof of identity, individuals must be able to prove their identity, address and date of birth, before receiving it. Many residents are unable to produce the required identity proofs for a variety of reasons that include never having had identity documents, having lost documents, possessing unofficial documents or documents that are only recognized locally. A related obstacle is

availability of proof of address documentation. An address in itself is prerequisite for the Aadhaar number, but it may also serve as a means of providing additional identity information. The UIDAI accepts a range of traditional documents such as bank statements, voter ID, driver's license or India Post's Proof of Address card to verify an individual's address. Other proofs that can be used include electricity or water bills not older than three months. Despite this range of accepted documentation, these documents may still be unobtainable for some individuals.

To solve these two problems (identity proofs and proof of address) the UIDAI created the "Introducer System". This system serves to make individuals who do not have a documented proof of identity, address or both eligible for an Aadhaar number. To do so, a Registrar designates certain individuals as "Introducers", persons who may vouch for the validity of a candidate's personal information. Introducers are volunteers and are typically individuals who have high standing or good knowledge of a community, such as local authorities, postmen, NGO officials, teachers or doctors. In order to be an Introducer an individual must already have an Aadhaar number, be older than 18, have no record of criminal offenses and must be accessible to residents. Through this system, individuals without documentation can now play an official role in society and may be entitled to public welfare benefits.

The Unique ID project also faces obstacles in terms of delivery of the Aadhaar number. Under normal circumstances, the number is sent to the address provided (the "mailing address") within 60-90 days of enrolment. India Post is then charged with delivering letters with the Aadhaar number. However, inaccurate or unclear addresses may prevent or delay delivery. To respond to these problems the Registrar stresses the importance of giving the correct mailing address and relies upon address proof documents.

Privacy and security are two of the main issues surrounding the Unique ID project. Some groups fear that the collection of so much personal information, including biometrics, may constitute an invasion of personal privacy, which could be exacerbated were there to be a security breach of the system. The UIDAI has assured these groups that it has undertaken efforts to safeguard security and privacy. These include using a randomly generated number, collecting limited information, not collecting profiling and tracking information (caste, community, religion, income, etc.), and verifying identity only through yes or no answers. The Unique ID database is also guarded both physically and electronically by a limited number of individuals with high clearance. The data are protected by strong encryption and a highly secure data vault.

Project progress

The first Aadhaar numbers were issued to residents in the village of Tembhli, Maharashtra, on 29 September 2010 (Byatnal, 2010). Over the subsequent five years, the UIDAI plans to issue 600 million Aadhaar numbers with the help of various Registrars across the country.

The cost per enrolment varies depending on the scale of enrolment, the equipment used and the training plan, but it is believed that the cost to issue each personal Aadhaar number is about 3 USD (Polgree, 2011). In contrast, application for an Aadhaar number is free for individuals.

Benefits

The Unique ID project will serve to create benefits for multiple stakeholders across India. From individuals to government agencies to the private sector, the project will impact the way identity is used in India.

At the individual level the Unique ID project will provide individuals with an identity not tied to community, caste or religion, but to their unique personal data. Individuals can use their Aadhaar number as an authentication mechanism to access up-to-date information about their entitlements and to demand services and redress their grievances directly via mobile phone, kiosks or other means. The Aadhaar number can be used anywhere in the country to confirm an individual's identity. This is especially beneficial for individuals who migrate from villages to cities and run the risk of losing their only link to their membership communities.

In addition to securing identity, government agencies will be able to expand benefits by supporting the development of better municipal services and by investing in more sustainable urban planning. The poor and marginalized, who have traditionally been excluded because of their absence of identification documents, will have a more balanced access to national opportunities. These initiatives will increase transparency and improve government accountability. At present, having an Aadhaar number is a voluntary process; however, in the near future this may change as agencies that provide goods and services may begin requesting an Aadhaar number to verify identity and permit access to these services.

The Unique ID project will also help to connect individuals to the market. Individuals with a clear proof of identity can enter into the formal banking system and fulfil the criteria of KYC policies required at financial institutions. KYCs oblige institutions to identify their clients and to gather relevant information before entering into business with them, so as to reduce the risk of fraud and money laundering. This process usually includes basic identity information, which means that poor residents have had difficulty in some cases proving their identity and address. However, the authentication offered by the UIDAI will help to reduce such documentation requirements and will lower KYC costs for financial institutions.

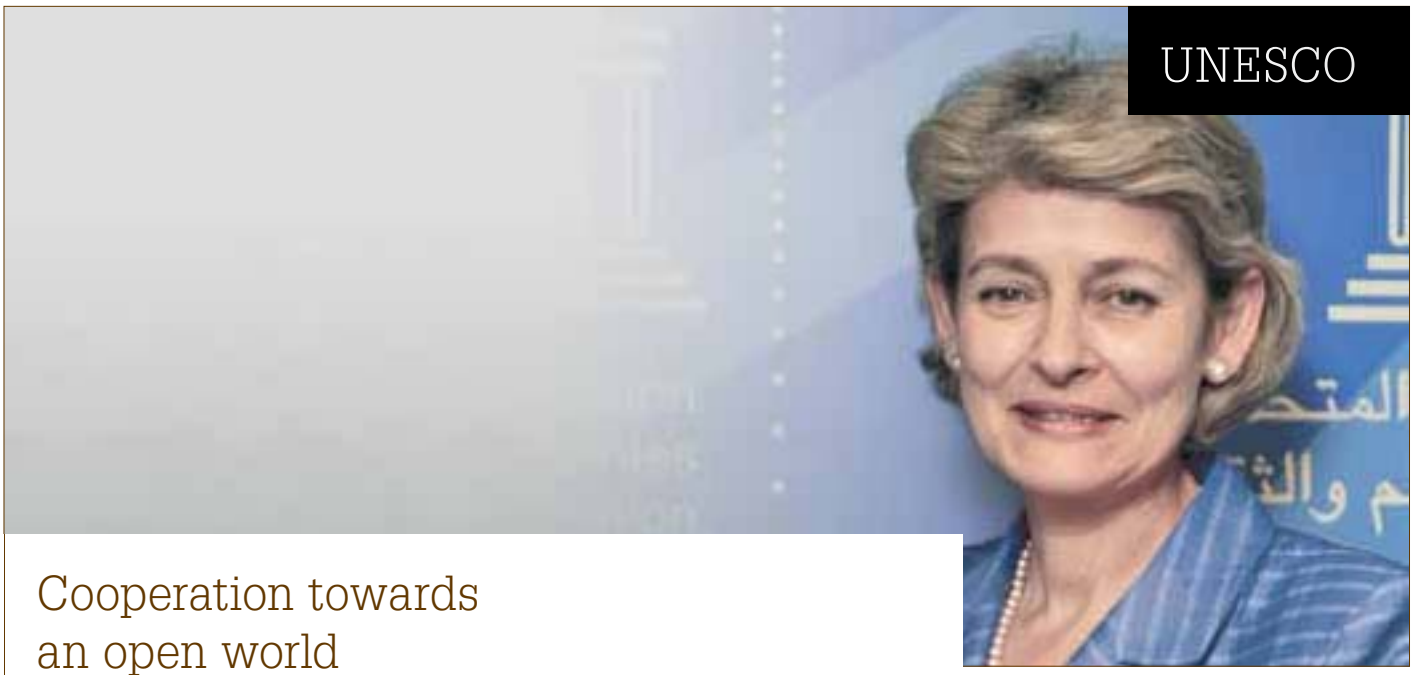
It is also expected that the project will help to create jobs and provide commercial opportunities for businesses. These include software and hardware firms, but also postal and telecom operators and other ICTs providers (Dass, 2011).

1) For further details, see: http://www.uidai.gov.in/registrar-link-2.html
2) "Know Your Customer" is a policy that requires financial institutions to identify their clients and gather information relevant to doing business with them, in order to reduce the risk of fraud and money laundering.
3) For further details, see: http://www.uidai.gov.in/what-is-aadhaar-number.html

Dar-es-Salaam, Tanzania

Part III

Partners in the initiative



Cooperation towards an open world

Education lies at the heart of UNESCO's work to build a culture of peace and promote sustainable development. To this end, education must be of high quality and impart the right skills and knowledge. It must also be inclusive and equitable, reaching all members of all societies. Open and accessible information and communication are essential for the attainment of these goals.

Countries across the world have made great progress towards the "Education for All" objectives set in 2000. Nonetheless, high barriers remain to be overcome. Some 796 million adults are illiterate, of which two thirds are women. An estimated 69 million children do not receive primary school education, while many more leave school without basic literacy and numeracy skills. Millions of learners endure conditions of poverty and discrimination, exacerbated by illiteracy and lack of access to information and knowledge, including poor connectivity. The price for societies is high.

The "Addressing the World" initiative of the Universal Postal Union (UPU) seeks to tackle a major challenge by providing billions of citizens with a physical address, a fundamental necessity both for the personal identity of learners and for access to education and other public services.

This goal is in line with UNESCO's mandate to build inclusive knowledge societies that incorporate the use of information and communication technologies to achieve open access to quality education. UNESCO's position is clear. Communication, information and knowledge are drivers for sustainable development. They are essential tools that enable individuals to exercise their rights, develop new capacities and improve their lives.

UNESCO is supporting the "Addressing the World" initiative by working with the Secretariat of the Universal Postal Union on two strategic programmes.

The first programme concerns Free/Libre and Open Source Software (FOSS/FLOSS). This refers to software that is liberally licensed to grant users the right to use, copy, study, change and improve its design through the availability of its source code. UNESCO will cooperate with the UPU in the research and evaluation of FOSS-based tools for addressing systems, in order to identity those that best match the requirements of member states. Sustainable solutions and local capacity building will form core parts of this cooperation.

The second programme targets Open Educational Resources, a UNESCO flagship priority. These resources consist of learning materials and tools in the public domain, or released with an open license (such as Creative Commons), that permit free and legal copying, adaptation, use and re-distribution by users. UNESCO will assist the Secretariat of the UPU to transform relevant existing training materials from copyright to open licenses. We will develop partnerships with ministries of education and universities to launch training programmes and lead workshops to build the capacity of education partners of the UPU.

It is essential that this work reach those who need it most. This includes least developed countries, especially in Africa, and small island developing states, as well as girls and women across the world. To be effective, national governments must step up their commitment to expand access to information and knowledge through effective national infrastructure and open access networks for the benefit of all.

Investing in accessible and quality education through open information and communication networks is essential for sustainable development. It is also vital for empowering women and men, girls and boys, across the world.

Irina Bokova

Director General, United Nations Educational, Scientific and Cultural Organization (UNESCO)

Linking physical and electronic addresses

Today, addresses go far beyond simple geography; notably in the digital world, where digital addresses are of fundamental importance in information and communication technologies, without which there would be neither phone calls nor e-mail. In today's world, individuals' social and economic participation hinges on their access to both postal and communication addresses.

In fulfilment of the international community's commitments to the Millennium Development Goals, both the International Telecommunication Union and the Universal Postal Union must pave the way to an effective, equitable and beneficial path towards development and inclusion. In this context, the right to communication plays a critical role. We must recognize the critical importance of interconnection and convergence between addresses' electronic and physical dimensions, and then ensure that all of the world's people are connected, whatever the means of communication. One dimension of this task relies on the work of our Telecommunication Standardization Sector, ITU-T, in the essential topics of addressing know-how; identity management of persons and objects; security; privacy; confidentiality; and internationalization. The ITU's contribution to this publication summarizes one facet of the important role of addressing, and the possibilities for the convergence of physical and digital addresses for the benefits of all in a globally interconnected society.

Dr Hamadoun Touré
Secretary-General, International Telecommunication Union (ITU)

UN-HABITAT

Addresses are critical for people and cities

At UN-HABITAT, we are convinced that everyone has the right to an address. If you do not have an address, you do not officially exist. Furthermore, an address for everyone is as important for a city as it is for an individual. It enables a city to know how many citizens it has and where they live. It enables a city to collect taxes and improve the lives of its citizens, and to provide basic urban services, such as water and sanitation infrastructure, transport, climate change resilience and crime prevention. The list is almost endless. An address is essential for the individual.

As we witness a slowdown in world economic growth, the impact on the world's poorest and most vulnerable is already evident. The economic crisis and the growing number of disasters wrought by climate change threaten to undo, and possibly reverse, much of the progress made towards achieving the Millennium Development Goals.

Slum prevalence is highest in sub-Saharan Africa, where today some 199.5 million people, or 61.7% of the urban population, live in slums. This is followed by Southern Asia, with 190.7 million (35%) urban slum residents, Eastern Asia with 189.6 million (28.2%), Latin America and the Caribbean with 110.7 million (23.5%), South-Eastern Asia with 88.9 million (31%), Western Asia with 35 million (24.6%), North Africa with 11.8 million (13.3%) and Oceania with 6 million (24.1%).

These figures from UN-HABITAT's flagship report, the *State of the World's Cities*, show that one out of every three people living in cities in the developing world lives in a slum. If no remedial action is taken, their number is projected to rise to 1.4 billion by 2020. This implies that developing countries will face even greater urban poverty problems than they do today.

There exist international statutes and instruments that cover the human and civil rights of us all, including the right to adequate shelter and the right to clean drinking water and sanitation. But if you do not have an address, you are a "non-person".

More than anything, cities need sound policies and the political will to back them up. They must have strengthened institutions and trained managers to run them. They need a responsible business sector and an enlightened public sector that work hand in hand. And they must have an informed public with the active participation of the communities most in need.

In this new urban era, time is not on our side. In a modern world where we have the technology, resources and know-how to do better than the Millennium targets, we have no excuse for failure.

Political leaders are encouraged to make the necessary decisions to include addresses in their national policies and to commit to this important initiative. UN-HABITAT supports the objectives of the "Addressing the world – An address for everyone" initiative. We reaffirm our belief that it will be of great benefit to our own *World Urban Campaign* for better cities. In this regard, we congratulate the UPU and welcome you as city changers and partners in this important quest.

An address is the key to a new life.

Dr Joan Clos

Under-Secretary-General,
United Nations
Executive Director, United Nations
Settlements Programme (UN-Habitat)

African Union Commission

Ensuring a better quality of life in Africa

The African Union (AU) was founded in 2000 with the vision of creating an integrated, prosperous and peaceful African continent driven by its own citizens and representing a dynamic force in the global arena. Implicit in this vision is the right of African citizens to socio-economic development. Expert forecasts on Africa's future further reinforce the African Union's role as an engine of African development. According to a recent joint study, human capital will be the major driving factor in the continent's development in the next decades (ADB/AU/NEPAD, 2010).

A few key facts and figures:

- The United Nations Population Division has projected that the African population will reach 1.5 billion in 2030 and 1.7 billion in 2040.
- The exponential growth of the African population in recent decades, at an average annual rate of 2%, has led to an increase in the young active population. This contrasts with the global ageing trend and will be an asset for African economies.
- The rapid urbanization of Africa means that 50% of the population will live in urban areas by 2030. More than 130 African cities will surpass 1 million inhabitants; 16 of these will exceed 5 million and another six will reach more than 10 million.

This population surge represents an important opportunity for economic growth, but also a great challenge for us all. Given the large potential for expansion of Africa's growing economies, investment opportunities abound (Kaberuka, 2010). In this context, reliable infrastructure is a prerequisite for guaranteeing investment that supports broader economic growth and, consequently, poverty reduction. In contrast, lack of physical infrastructure, affects the quality of services, reduces the competitiveness of businesses and undermines the implementation of economic and social policies in African countries.

In Africa, less than 40% of the population has access to electricity, only 34% has access to improved sanitation, and 65% has access to clean water. Only about one third of the rural population has access to roads. Moreover, only 4 out of 10 Africans have access to mobile phones and fewer than 1 in 10 have access to the Internet. With this in mind, the AU Commission has undertaken a programme for the improvement of infrastructures in order to achieve the vision of the founding fathers of the African Union. Since 2007, the AU Commission, the African Development Bank (AfDB), the New Partnership for Africa's Development (NEPAD), and the United Nations Economic Commission for Africa (UNECA) have been working hand in hand to develop the Programme for Infrastructure Development in Africa (PIDA).

PIDA aims to facilitate regional integration, in fulfilment of the African Abuja Treaty, by establishing a strategic framework for the development of regional and continental infrastructure. The programme includes a priority action plan and an implementation strategy, covering four sectors (energy, transport, information and communication technologies, and transboundary water resources), to be achieved by 2040. The AU is aware that the success of PIDA depends on the support provided to other sectors and programmes.

A clear example is the case of addressing systems, which are an important infrastructure for social integration and economic development. Addresses help people to be recognized as citizens and enable the distribution of basic goods and services. Although addresses play an important role in Africa's overall infrastructure, the continent is suffering from an ongoing lack of addressing. The increasing flow of people into cities puts greater pressure on the development and management of urban areas. Spontaneous settlements emerge with no planned road infrastructure making it difficult to locate individuals who live there. This

prevents people from being identified and recognized as integral parts of society. Good infrastructure, including address infrastructure, can help remove impediments to the movement of people, goods and services, which in turn can guarantee decent living conditions for all, thus contributing to economic growth in the continent.

From our point of view, addresses must be recognized as key drivers of economic and social development. Addresses enable governments to understand the needs of their territory and citizens; they enable individuals to be formally recognized as part of society and to participate in the democratic process; and, finally, they enable companies to do business and be easily identified by potential customers and other businesses. Addresses are a preliminary condition for the provision of and access to services. There are many examples of products and services that are challenging, if not impossible, to obtain without an address, including a bank account or a mobile phone subscription. What is more, other government services, such as utilities, cannot be extended to all of society without the existence of a sound address infrastructure.

Recognizing the key role of addresses as an infrastructure, and in view of the development of national and regional infrastructure through PIDA, the AU Commission has decided to include address infrastructure as a priority in its current and forthcoming strategic plan. Within this framework, guidelines will be provided to member states to encourage and support them in initiating and implementing addressing systems.

We would like to thank UN-Habitat, the Universal Postal Union, the World Bank and other stakeholders for their efforts in promoting the value of addressing, which have contributed to integration and development. The AU Commission would now like to pursue these activities in Africa.

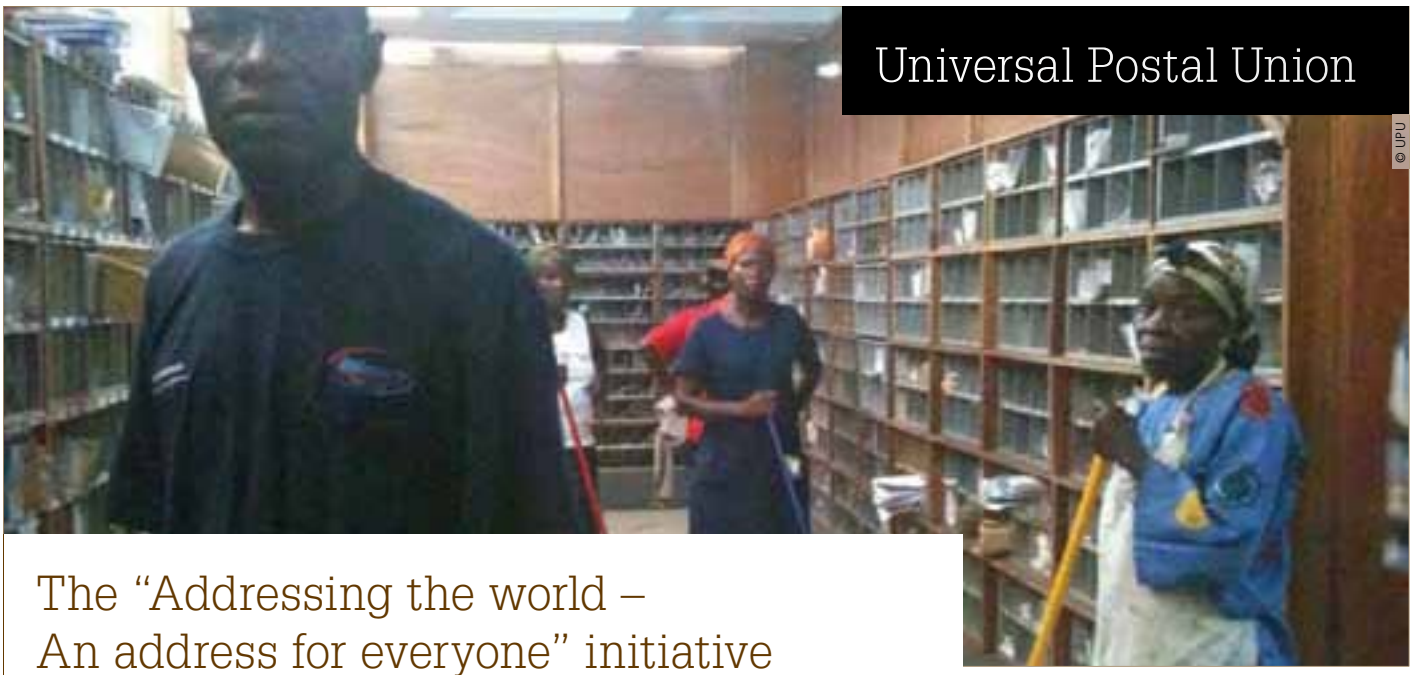
We strongly encourage member states to establish addressing as part of their national strategies, as stated in the AU's "Action Plan for the Sustainable Development of the Postal Sector in Africa". We believe that, by improving their addressing systems, countries will open the door to numerous social and economic benefits and reinforce the integration of Africa.

However, we cannot undertake these efforts alone, given the significant resources and expertise necessary to implement address infrastructure. We would therefore like to urge our traditional partners and donors to provide the required support, and we also call on our national actors (ministries of finance, home affairs, land, security, and information and communication technologies; postal regulatory bodies; postal operators; municipalities, etc.) to promote synergies among their actions.

Together, we can improve the living conditions of our citizens in Africa through the provision of proper address infrastructure.

Dr Elham M. A. Ibrahim
Commissioner, Infrastructure and Energy,
African Union Commission (AU)

Universal Postal Union



B.O. Box delivery office in Freetown, Liberia

The "Addressing the world – An address for everyone" initiative

In 1874, the Universal Postal Union (UPU) was established as the primary forum for cooperation between postal players. From its inception, the UPU has been tasked to serve as an advisory, mediation and liaison body. Over time, the UPU's focus has evolved to facilitate: (1) the establishment of rules for international mail exchange between its 192 member countries, (2) the free flow and growth of international mail, and (3) the promotion of a genuinely universal network that provides modern products and services.

The physical, electronic and financial dimensions of postal networks enable Posts to participate in the development of economies, societies and trade, and work towards narrowing the digital divide. Since 1948, the UPU, as a United Nations (UN) specialized agency, has also contributed to the development of UN policies and activities that have a direct link with its mandate. This includes the promotion of social and economic development within member countries in view of achieving the Millennium Development Goals (MDGs).

Addresses, as a basic element of communication between individuals, public institutions and businesses, not only serve to expand the postal market, but also help to fulfil the worldwide goals of social and economic development. Sound addressing systems form the basis of efficient mail delivery and are, therefore, a key component of the activities of UPU and its world postal network. However, addressing is not only about writing letters, it is about locating people and places around the globe, regardless of location, personal status or gender. The reality is that the addressing issue goes far beyond the postal sector and needs to be understood as a major concern in many countries, both developing and industrialized.

Physical addresses are taken for granted in most industrialized countries. But for billions of people, addresses effectively do not exist. In many developing and least developed countries, addressing systems are either inexistent or only partially developed. The principle cause is large population movements from rural to urban areas, which have taken place in recent decades in countries worldwide, resulting in demographic explosions in cities. The consequent vast urban growth in formal and informal settlements alike has rendered many individuals and locations unknown and inaccessible. These conditions have a detrimental impact on the provision of public services, and affect the ability of national and international organizations and businesses to operate efficiently, particularly those related to postal business and emergency services.

With this in mind, the UPU has taken steps to advance the addressing issue. Through the launch of the "Addressing the world – An

UPU UNIVERSAL POSTAL UNION

address for everyone" initiative in 2009, the UPU committed to promote the development of sound address systems providing addresses for all. The present white paper aims to move the initiative forward by demonstrating to political leaders the importance of investing in addressing infrastructure.

The UPU and addresses

Since 1999, the UPU has been involved in helping member countries to improve their addressing systems. Requests for assistance come from governments or from postal operators. The UPU assists national authorities in two main areas: in the design of methodologies to develop and disseminate the use of physical and postal addresses, and specification of the prerequisites for developing postal addressing standards to allow interoperability of systems at the international level. The UPU also helps countries to assess their needs with regard to the reorganization of mail processes, and creates databases and related tools that help postal services to reach customers everywhere in a qualitative manner.

Currently, around 60 countries have requested some type of assistance from the UPU. In Africa alone, around 80% of countries are involved in an addressing project. Open projects can be found in Botswana, Cameroon, Ethiopia, Eritrea, Mali, Malawi, Namibia, Nigeria, Sudan, Tanzania, Uganda, Zambia and Zimbabwe, among others.

In a number of developing coutries, lack of physical addresses renders postcode and database projects difficult, and addressing systems must be created for the entire country. However, national addressing projects extend beyond the scope of the postal sector to integrate a variety of local and national stakeholders, and as such are complex and difficult to implement. In addition, addressing projects can last from three to five years, and require a comprehensive action plan supported by the highest levels of government and sufficient resources.

Unlike many developing countries, emerging countries do not need to build their addressing systems from scratch. Nevertheless, they also need support to improve their current addressing systems, extend their information systems to include delivery point databases (street names and house numbers) and change-of-address systems, and acquire technological tools such as geographical information systems that meet the requirements of their markets in a sustainable manner. Keeping postal databases updated and developing systems that allow data to be enriched and purged of obsolete information is vital for all stakeholders. Industrialized countries, where addresses have already proved to be an important tool for social and economic development, could serve as benchmarks for emerging economies.

Through its work, the UPU has gained a strong understanding of the impact addressing systems can have on development. Addressing needs to be understood as a major issue impacting many developing and industrialized countries worldwide.

Critical areas of work

The UPU's 24th Congress, held in Geneva in 2008, defined four different areas of work to advance the organization's work on addresses: postal addresses, address standards, postal databases and electronic addresses.

Postal addresses, comprised of street names, house numbers and postcodes, allow locations to be uniquely identified, thereby facilitating postal market expansion and improving the delivery of goods and services. In contrast to P.O. Box addresses, location addresses are considered a priority for the UPU because of their potential to link individuals to a unique location and to expand universal service. The UPU assists countries in developing national addressing systems by contributing to the design of methodologies that create postal addresses and support their dissemination. In addition, it helps postal services to assess the prerequisites for mail process reorganization and database development with a view to developing door-to-door delivery and offering products and services adapted to the digital age.

Addressing standards enable interoperability among existing address information (allowing for communication across different languages or different writing systems), facilitate mail handling (automatic sorting, distribution), and provide guidelines to build and maintain address infrastructures and facilitate the development of national standards. The UPU aids member countries in creating standards that define postal address elements, templates and formats for electronic exchange of name and address data. The UPU has developed two standards: S42, which seeks to make international name and address information interoperable, and S53, which specifies the format of electronic exchange of name and address data. These standards have been developed in cooperation with other organizations working in this domain, including the European Committee for Standardization (CEN), the Infrastructure for Spatial Information in the European Community (INSPIRE), EURopean ADdress INfrastructure (EURADIN) and the International Organization for Standardization (ISO).

Postal databases and technical tools to manage addressing information improve the quality of postal service delivery by gathering, analysing and processing international postal data. Organizations worldwide, whether commercial or non-commercial, are users or potential users of postal address databases, and the value of these databases increases as more details are included. The UPU offers solutions for cleansing, validating and standardizing international addresses and advises designated operators regarding addressing products and services. These important functions transcend the Post and benefit both public and private sectors.

Electronic addresses are a commonplace part of contemporary communication and are critical for the future of the postal sector. At present, the UPU is working on ways to link physical and electronic addresses so as to provide technical solutions to support the development of e-commerce. In the industrialized world, many people have multiple e-mail addresses and digital identities issued by various unregulated organizations, operating without any global accountability framework. In this context, addresses can serve as a way of verifying identity. A hybrid digital-physical address could be used to validate credit cards in e-commerce transactions, to improve the quality of service for delivery of goods, and to store accurate delivery data for security and law enforcement agencies. It is worth noting that the promise of e-commerce cannot be realized unless there are identifiable physical locations and individuals to which products can be delivered.

Implementing a sound addressing system

The UPU undertakes addressing projects in these four work areas, deploying its expertise to provide technical assistance to member countries.

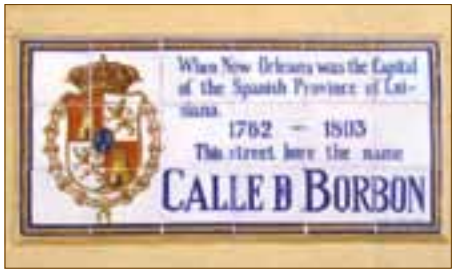
First, the UPU prepares a feasibility study, including an assessment of the existing addressing system and main challenges to its development. Second, the experts examine the postal operational system to identify current problems and system bottlenecks. The addressing project also evaluates the standards and postcode system in use and its structure, coverage and completeness. This information provides the UPU experts with a basis to identify strengths and weaknesses in the existing system. The next stage is preparation of an action plan, including proposals based on the needs of different actors, timelines, resources, and so on.

The modern development of the postal sector also calls for the consideration of information management systems and postal market prospects. The first step should include a study of the types of systems used and the coverage of existing address database management systems, mail delivery management systems, digital map systems and so on, as well as an analysis of other non-postal initiatives. These systems aid postal operations, but also help to expand the postal sector's market. An addressing project must consider the postal sector's current market portfolio (by designated postal operators and others), and potential opportunities for development from new addressing standards, postcodes and information management systems. Private sector participation should not be overlooked as an opportunity to strengthen the Post's market position.

Furthermore, addressing is not just a postal issue; any addressing project must integrate both postal and government perspectives. The responsibilities of different groups should be analysed to ascertain who is accountable for addressing efforts such as street naming and house numbering and the precise nature of the prevailing legal environment. The general use of addresses and postcodes should be promulgated to individuals, governments and businesses to ensure their acceptance and use throughout the country.

Creta, Greece

Address on an envelope



New Orleans, USA

"Addressing the world – An address for everyone"

The UPU's 24th Congress recognized addressing as a strategic priority and charged its bodies with fostering continuous dialogue with other international organizations. It proposed that the UPU seek partnerships with donor agencies and intergovernmental organizations when carrying out projects aimed at implementing and improving addressing systems at the national or regional level. This decision laid the foundations for the launch of the "Addressing the world – An address for everyone" initiative in 2009.

The UPU brought the initiative to a meeting of the UN System Chief Executives Board (CEB) and organized consultations among UN organizations involved in addressing, with the objective of underlining the importance of the subject for the global development agenda and mobilizing the international community to tackle the issues involved. The UPU aimed to create synergies between UN organizations, intergovernmental organizations and other interested parties, such as academia, non-profit organizations, development banks or businesses. The objective was to obtain a broader view of addressing issues, and to define and help to implement an action plan taking into account the views of the different players involved. The ultimate goal of the initiative is to provide everyone with an address.

The level of involvement of each organization participating in the initiative has been highly dependent on their role as providers or users of addresses. Providers aid in the provision of addresses internationally, such as through the creation of standards or policies, while users need addresses to fulfil their mandate and activities or to deliver services. To achieve the goal of the initiative, the UPU concluded that efforts should be concentrated on working with organizations that have a specific mandate or interest in addressing, and in encouraging political leaders to commit to the initiative, as well as restricted postal unions and other intergovernmental organizations. The postal industry expressed its willingness to provide support and further promote addressing, and has been actively involved in the initiative. These actors provide knowledge and expertise of new solutions aimed at the development of common specifications for new and cost-adapted technologies to help increase the total number of people and businesses with addresses.

Conferences

Since 2010, the UPU and its partners have organized numerous conferences and meetings

to advance discussion on addressing and raise awareness of the initiative and its goals.

In April 2010, the UPU's Consultative Committee held a Global Addressing Summit focused on the private sector and business use of and relationship to addresses, and the economic benefits thereof. The Summit focused on four aspects surrounding physical addresses: the economic benefits of an address and address system, interoperability (cross-border mail or post-private courier relations), customer perspectives (costs of redelivery and wasted mail) and standards.

Later that month, EURADIN, a UPU standards partner, invited the UPU to present the "Addressing the World" initiative at the European Address Forum (EAF). This forum provided the UPU with an opportunity to communicate more broadly with workshop participants, who ranged from public authority representatives to researchers, academia and the private sector.

In September 2010, the UPU presented the "Addressing the world" initiative at its Strategy Conference in Nairobi. The objective was to demonstrate that addressing is a crucial economic and social issue, not just for postal operators, but also for customers, governments, citizens and businesses across the international community.

In November 2010, the UPU hosted a conference in Bern that sought to strengthen the role of postal operators in addressing and to showcase addressing activities carried out by other stakeholders. The conference provided participants with a better understanding of the value of addresses, while a series of case study presentations enabled member countries to share experiences and discover possible solutions to addressing issues. Representatives from governments and other international and regional organizations involved in addressing issues, such as the ISO, the World Bank, the EAF and others, enhanced the conference.

Research phase

After launching the initiative at the international level, the UPU consulted with academia, research institutes and business schools regarding the value of addresses for social, political and economic development.

The UPU also completed work on an "addressing" indicator in connection with the World Bank's "Doing Business" index. The indicator measures and quantifies the constraints involved in obtaining a new address, based on the World Bank's methodology of ranking the ease of doing business in countries. Two studies were carried out to observe the effect of addressing on business. The results showed that businesses face significant difficulties in the absence of sound addressing systems. The ideal situation for a business seeking to obtain a new address was found to be a coordinated process between relevant agencies, as close as possible to the local level, following clear addressing standards. The process should be as cheap and as short as possible, and involve the least number of documents while facilitating access for the most people and businesses.

White paper

In the framework of this initiative, and on the basis of the research and collaboration described above, the UPU resolved to prepare a white paper that tackled the addressing issue. The purpose of the paper is to facilitate the governmental decision-making process regarding addressing policies and to encourage political leaders to commit to the development of an address infrastructure.

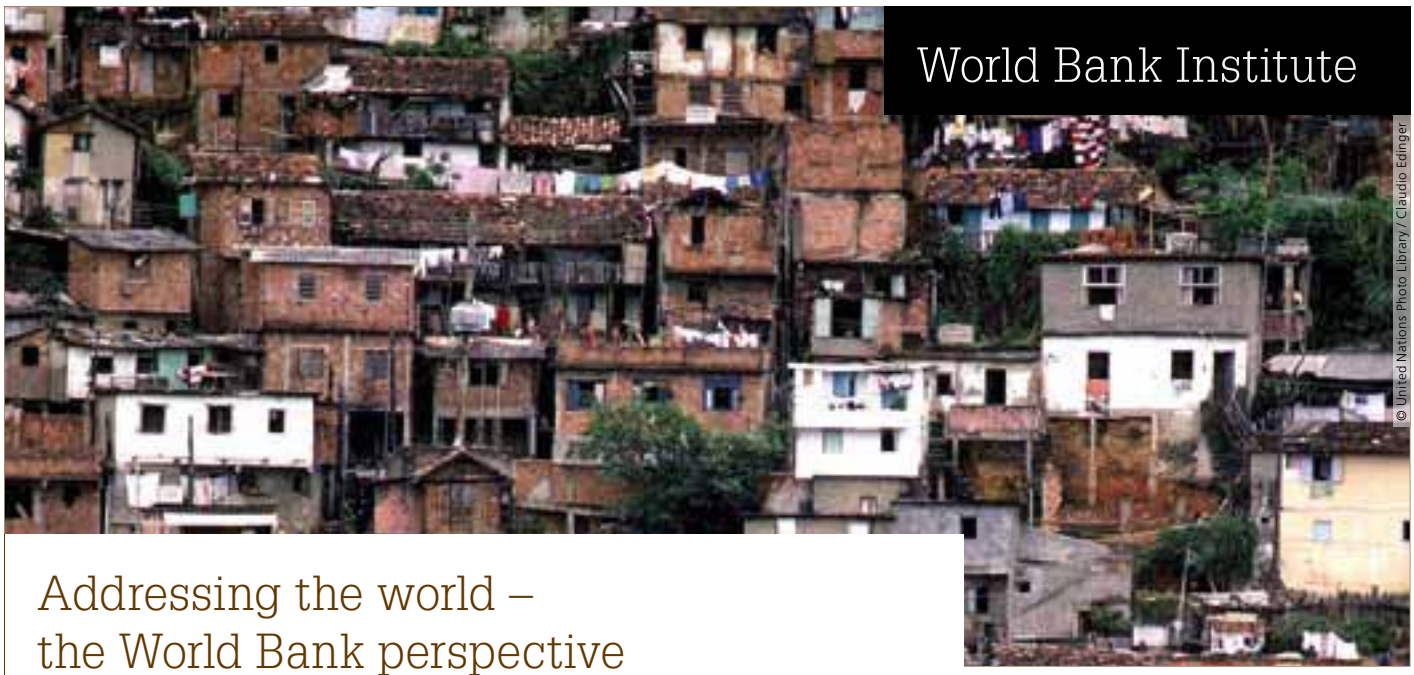
To achieve this goal, the white paper compiles information on the value of addresses for economic and social development. To provide a comprehensive analysis of address infrastructure, the white paper considers different perspectives (historical, theoretical and practical), providing evidence that addressing is an invaluable infrastructure that should be available for everyone. Case studies from different countries are included to show the different paths available for developing addressing projects and the different motivations for embarking on projects.

In the end, this white paper seeks to emphasize the point that the benefits of a national address infrastructure can only be achieved with the support of national governments. Ensuring that everyone has an address must be understood as a matter of potential global benefit. For this reason, the white paper is accompanied by a solemn declaration that spurs countries to commit to the development of address infrastructure and the provision of an address to everyone. We expect the declaration to be endorsed by UPU member countries at the UPU Congress in Doha, Qatar, in 2012.

Beyond the benefits that addresses provide to individuals, governments and business, our collaboration with other organizations and our research on the value of addresses has revealed that addresses provide immense benefits at the global level. The support offered by our fellow international partners confirms that this is particularly true of development organizations, such as the United Nations organizations, whose activities suffer from the absence of addressing systems. This is particularly apparent when dealing with outbreaks of diseases or natural disasters, where lack of a clear addressing system at national or international level may have a tragic impact on populations if the delivery of critical materials is lost or delayed. The presence of a good addressing system can prevent or at least mitigate significant negative effects and losses on investments.

Conclusion

The UPU is able to provide technical know-how regarding the implementation of sound addressing policies, but it is unable, alone, to provide an address for everyone. The wide scope of the address issue transcends the postal environment, and the complex nature of addressing projects is further challenged by the lack or very limited presence of addressing systems in more than 60 countries worldwide. All countries and other international and regional stakeholders are therefore called upon to work with the UPU to implement this initiative and to help ensure its success. In this section, eight of our international partners have contributed to the white paper by sharing their addressing experiences. Each of their contributions demonstrates a different facet of addresses and the role they play, both nationally and globally. The support of our partners helps to remind us that addresses form a necessary infrastructure, and one which many other policies are dependent upon.



Rio de Janeiro slum, Brazil

Addressing the world – the World Bank perspective

World Bank Institute

World population has reached the 7 billion threshold and urbanization has become the defining phenomenon of the twenty-first century. For the first time in history, more than half of the world's population lives in cities, with 90% of urban growth taking place in developing countries. Over the next 20 years, over 2 billion new urban residents are expected, with 1 billion already living in slums. In West Africa alone, 63% of the population will be city dwellers in 2020 (270 million out of 430 million). Within 10 years, the urban population of West Africa will increase by 43 million. The traditional image of an essentially rural Africa and a rural world is increasingly out of touch with reality.

Growing urbanization has resulted in decentralization as greater responsibilities are devolved to emerging local governments. This wave of decentralization has impacted most countries, and the World Bank has supported this process through a number of projects/programmes that aim to respond to the priority needs of local beneficiaries. The main challenge ahead is to improve the governance and management of cities in a sustainable fashion, in a context of economic difficulties and weak technical management capabilities.

A second, dual challenge is to reconcile the economic growth of cities and poverty reduction. The main objective is to make cities function better so that they can provide basic services and create an enabling environment for trade and economic activities.

One way to meet these challenges is to improve the know-how of city managers and urban practitioners and to introduce some practical city management tools. Street addressing is one such tool.

Why is street addressing important?

Growing urban populations and the trend for decentralization present major challenges for urban management in developing countries. In many cases, systems for locating, mapping and identifying streets, buildings and plots have not kept pace with urbanization. This creates a worrisome predicament for urban services. With no system of spatially locatable coordinates and no baseline information, how do you find your way around a constantly growing city? How do you dispatch ambulances, fire fighters and law enforcement personnel quickly? How do you send mail and messages to homes and businesses? How do you locate urban facilities and infrastructure and maintain them? How do you pinpoint breakdowns in water, electricity and telephone systems? How do you complain about potholes and lack of services? How do you improve bill collection for water

and electricity? How do you set up an efficient system for local taxation? How do you improve citizens' sense of belonging to and identification with a community, neighbourhood or city?

Makeshift solutions to these problems exist, but delivery of urban services according to these methods is generally problematic or ineffective. Over the past two decades, several donor-funded projects have been launched to improve urban information systems and set up sophisticated geographic information systems in developing countries. Some of these projects had only limited impact because the proposed approach involved techniques that exceeded available local resources and capacity. This lack of available resources in turn stimulated the search for a simpler, more progressive approach to urban information systems. Street addressing requires few resources and only a short implementation timeframe. It is intended to provide municipal authorities with an efficient system of baseline information on the city, allowing them to make informed decisions and apply high-performance management tools.

Since the mid-1980s, the World Bank has provided financing for street-addressing initiatives in several urban development projects. It has also published a manual entitled Street Addressing and the Management of Cities. This manual reviews the role of street addressing within the array of urban management tools, outlines current and future applications, highlights practices in several countries, and offers a methodology for implementing street-addressing programmes. The publication is available in English, French, Portuguese and Spanish. Moreover, on the basis of the publication, the World Bank (WBI Urban Practice) has developed an e-learning course currently available in English and Spanish.

What is street addressing?

Street addressing is a technique that shifts emphasis from plot-level demarcation/registration titling to occupancy units at the street level, and from property rights to occupancy status. It is an opportunity to:

- Create or update mapping of the city (1:10000);
- Codify streets in order to facilitate spatial location of buildings, infrastructure and land (includes doorway numbering and street signs);
- Conduct neighbourhood-level surveys;
- Establish a simple computerized database system and a street index; and
- Set up a reference for multiple municipal applications (e.g. solid waste, road maintenance, mail, fire/ambulance service, epidemic prevention, urban information systems, land management, public asset management, fiscal management).

Street addressing goes beyond mere urban management. Assigning individuals an identifiable location in the city provides both a physical and a symbolic connecting point for all citizens within the community. Street addressing is thus an essential avenue of recognition for the civic rights of all citizens.

For the public, addressing makes the city more "user-friendly" by improving the system of street coordinates. It enables people to get around the city more easily and locate urban facilities, and facilitates the delivery of emergency and security services.

For local governments, addressing increases municipal revenues and improves urban management through the use of the following tools:

- **Tools for planning and managing municipal services by technical departments. The identification of public assets** (street system, facilities, their length, number and condition) allows a monitoring system to be put in place to assist with urban planning and programming of investments.
- **Tools to improve local tax collection**. The use of information gathered by street-addressing initiatives makes possible the location and compilation of a register of taxable individuals or businesses, thereby facilitating a more accurate determination of the tax base.

For the private sector, addressing enables utility concessionaires to manage their networks more effectively. In fact, street addressing helps water, electricity and telecommunications concessionaires to maintain their networks and collect fees.

Street addressing and its eight key applications

Civic identity

Street addressing is one of many requirements that help a city to achieve social integration. It is a technical requirement for transforming a city from an informal space into a civic community.

Urban information

Through its surveys and spatial identification of locations, street addressing offers an exceptional opportunity to gather baseline information on a city. The database and maps created through such an initiative can form the basis of a geographic information system, which can then be used in conjunction with other urban management tools. It is, therefore, advisable to use address-management software that incorporates the standard functions of a database and is designed to handle the spatial dimensions of the data.

Support to municipal services

Street addressing has been used in a number of instances to support the delivery of municipal services. In particular, street-addressing data and mapping have been used to implement annual maintenance programmes for secondary roads and streets, and to design solid waste collection zones and transfer routes, thereby helping to improve municipal solid waste management. Moreover, few municipalities know the extent of their assets. Their infrastructure, buildings and land tend to be poorly identified and not spatially recorded. Addressing surveys present a unique opportunity to take stock of public assets. Additional information on the value of the assets and the cost of upkeep will enable the municipality to more effectively plan its annual operating budget. Finally, street addressing provides information on population, level of infrastructure and services in each neighbourhood. This information has proved to be very useful for needs assessment and planning of priority investments. In a number of countries, street addressing has been instrumental in supporting urban audits and Local Governments Needs Assessments, leading to municipal contracts.

Local taxation and revenue mobilization

Street addressing is an opportunity to re-examine the municipal taxation system. For example, addressing can be used to improve knowledge of the tax base and fiscal registers. In some countries, address directories and taxpayer rolls have been reconciled to create a tax register that includes both taxpayer rolls and address information. It can also be used to simplify the local taxation system, in particular, property tax. This constitutes a key local fiscal revenue, yet in many countries, there is little incentive for central tax departments to collect a tax that is devolved to local governments. Moreover, tax exemptions have been the overriding policy, preventing any substantial revenue increase, and it has proven difficult to use ownership as a basis for direct property taxation when many new land transactions are not accompanied by records and titles. Street addressing is an opportunity to rethink the basis for local taxation, shifting from tenure-based to occupancy-based taxes and from property value-based to service consumption-based taxes.

Land management

Many countries' land management systems involve cumbersome titling procedures, multiple claims on land and overwhelming informal urbanization. In this context, street addressing provides an opportunity to locate and monitor the real state of affairs on the ground. This should be a primary activity undertaken by local governments. The cadastral projects financed by the World Bank in Africa during the 1980s were designed with very high expectations. They sought to capture land transactions and provide the basis for substantial revenue mobilization at the local level. However, they were not as successful as anticipated. These projects, which called for a long-term effort, were abandoned as a result of several factors, which included complexity, the need to mobilize extensive resources, the need for constant monitoring, and inadequate local expertise. Similar experiences can be found in other regions of the world. With such projects it is now clear that there is a need to pace and sequence instruments or tools. Indeed, in many cases, it may be best to start with street addressing before moving to a cadastre (a comprehensive and perpetual inventory that describes and assesses the value of landholdings).

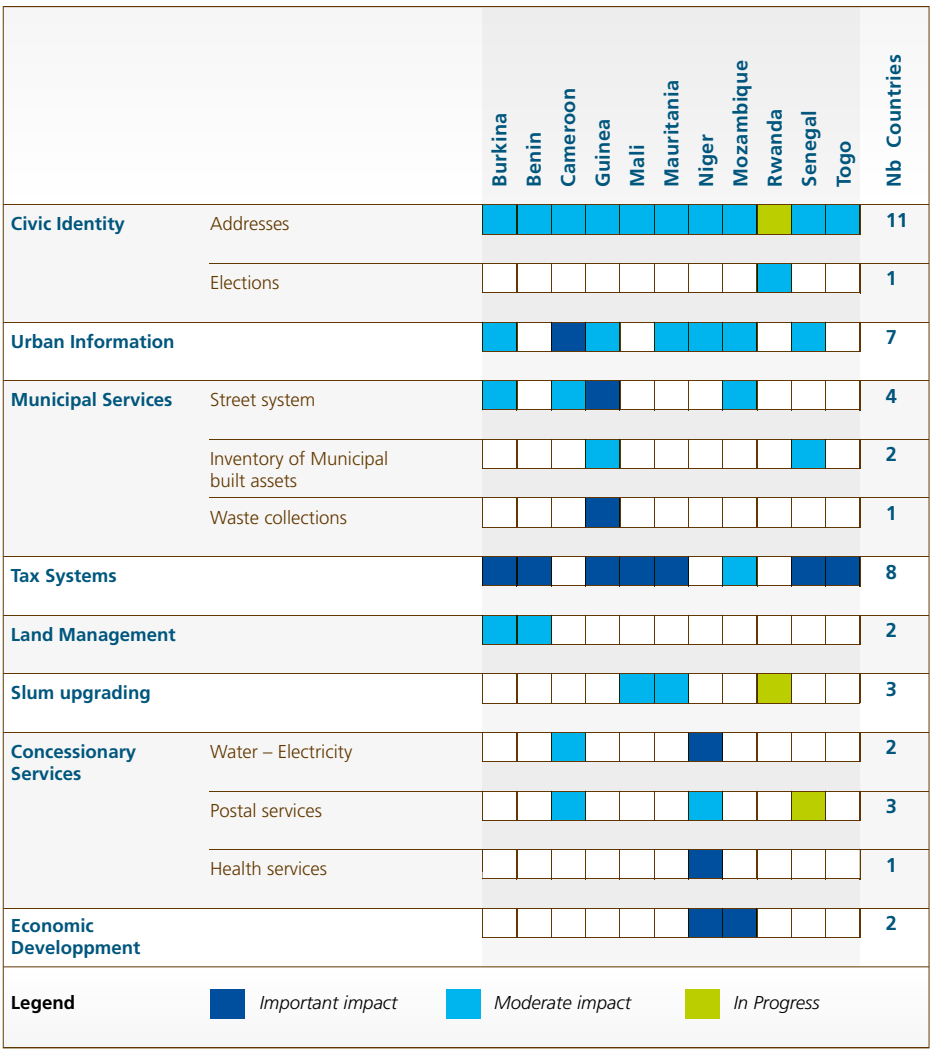


Figure 1. Applications of street naming by country

Slum upgrading

In the context described above, land registration generally covers less than 10% of the population, while urban areas continue to grow in an essentially informal way. Efforts to regularize land tenure (by issuing land titles), which were at the heart of a large number of upgrading programmes for underserviced neighbourhoods, have been largely fruitless in the face of such an extensive problem. Street addressing has emerged as an alternative to the formal regularization of property rights, which has largely failed to achieve results, particularly in Africa. Street addressing can be conducted as part of an upgrading programme or as part of a city-wide street-addressing programme. In both cases, the idea is to bring excluded neighbourhoods into the urban fabric and city management system (integrating them into the budget and the utilities networks), and not to become mired early on in insurmountable property rights issues.

Concessionary services

When utility concessionaires in urban areas (water and electricity) take part in street addressing, the results are often positive

in terms of information sharing, billing and network maintenance. For example, concessionaires frequently monitor the surveys and numbering of buildings, and require that future subscribers give an address, which then becomes a key identifier.

When it comes to postal services, private express mail delivery services and e-commerce are receiving renewed interest, after some hesitation given the widespread use of the post office box.

Economic development

The address directory provides important information on formal and informal economic operators. An economic database is a good barometer of a city's economic potential and the nature and location of activities taking place. In addition, by preserving the history of a location's changing uses, an address database provides a reliable indicator of the economic dynamics at work, and can serve to document trends. Private companies are usually interested in street address databases because they use them to tailor their business development strategies, while local governments use them to guide their economic development decisions.

Practical experiences: a sampling from Africa

The World Bank has supported street-addressing programmes in a number of urban development projects around the world. This review of practical experiences focuses exclusively on Africa. The sample includes projects in 52 cities in 15 countries: Benin, Burkina Faso, Cameroon, Chad, Congo, Côte d'Ivoire, Djibouti, Guinea, Mali, Mauritania, Mozambique, Niger, Rwanda, Senegal and Togo.

Figure 1 summarizes the street addressing applications used by the 21 cities that successfully completed their street addressing tasks. 1)

The number of countries that used applications is given in the right column: tax system (8 countries), urban information (7) and street system (4). These are followed by slum upgrading and postal services (3); inventory of municipal assets, land management, concessionary services and economic development (2); and elections, waste collection and health services (1). The number of applications implemented (including addressing) varies widely by country. Six countries have used between five and six applications: Burkina Faso, Cameroon, Guinea, Niger, Niger and Senegal. These are followed by Mauritania (4 applications), Benin and Mali (3), and Rwanda and Togo (2).

The sample taken from 21 cities that have successfully completed street-addressing tasks represents 11.2 million people. The population in the cities represented ranges from 80,000 to 1.3 million inhabitants. The overall budget for these operations totalled 6.8 million USD, for an average of 325,000 USD per project. In all, 84,000 street signs were installed and 1.2 million buildings were assigned an address, thus serving about 75% of all households. The average cost was 0.6 USD per capita and 5.7 USD per addressed doorway. Before street addressing projects were undertaken, only 8% of streets had names; in other words, 92% were unidentified.

Various donors contributed to financing the addressing effort, including the World Bank and the French Cooperation Agency, represented by the Ministry of Foreign Affairs (MAE) and other departments (Dezentralized Cooperation, Agence Française de Développement (AFD) and Association Internationale des Maires (AIMF)). These two donors have clearly worked closely together. In some instances, they divided their financing among cities for the same addressing project, for example, the Urban Development and Decentralization Project (PDUD) in Mali and the Urban Development and Decentralization Programme (PAC) in Senegal. In other cases, they helped to expand efforts launched by other donors (Burkina Faso, Cameroon and Niger).

Actual project implementation differs by country. A country's addressing project may involve one or several cities, ranging from one city in Guinea to 11 cities in Mauritania or Senegal. The operation was initiated either within the scope of a project unit (Burkina Faso, Cameroon, Mali and Senegal) or within the technical department of the municipalities (Guinea, Mozambique, Niger, Chad and Togo).

Addressing applications also vary by country. However, projects involving taxation were the most prevalent (residence tax in Burkina Faso and Togo, tax registers in Senegal and municipal taxation in Mauritania). Other applications involve urban management (street system and household waste collection in Guinea, Cameroon and Burkina Faso; an urban observatory in Cameroon).

Burkina Faso

The first street-addressing project financed by the World Bank took place in Burkina Faso. It was developed as part of the World Bank's Second Urban Development Project (UDP2), which had two components: mobilization of municipal resources and strengthening of urban infrastructure.

Launched in 1987, the street-addressing unit was attached to the Ministry of Finance. Urban taxation was a major issue, as new resources were needed after the abolition of property rights during the revolution. With the World Bank's help, authorities implemented two complementary applications: residence tax and street addressing.

Figure 2 shows Ouagadougou, Burkina Faso's capital, divided into sectors to facilitate street addressing and the implementation of the new tax system.

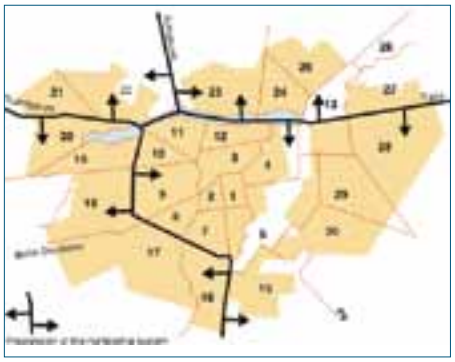


Figure 2. Ougadougou – Organization of street addressing into sectors

Cameroon

The crisis that hit the Cameroonian economy in the late 1980s resulted in a drastic reduction in resources available to the government to finance facilities, infrastructure and urban services. Studies implemented during the Second Urban Development Project revealed that the main problems stemmed from an inability to identify potential taxpayers and users of city services. The creation of an address system in the cities of Yaoundé and Douala seemed to be one way to solve these problems quickly and easily. The main objectives were: (i) to locate potential taxpayers to increase revenues, and (ii) to identify users of public services as part of efforts to privatize concessionaires of commercial city services.

In both cities, the project resulted in a much more influential addressing unit, which has become an urban observatory that gathers, processes and distributes information about the city. Furthermore, an address directory was created and sent to water and electricity companies and the postal services, becoming their primary tool for customer identification and resource mobilization.

Guinea

A recent decentralization policy resulted in the creation of five municipalities in Conakry. However, these municipalities had few resources at their disposal and possessed little information about their territory. They also lacked experience. Potential tax revenue was poorly evaluated, and the resources to implement any taxation systems were sorely lacking, so that fewer than 40% of tax assessment notices issued resulted in collection of tax. To help the new municipalities deal with these difficulties and build their capacities, an addressing component was included in the UDP2. As a result, Conakry was able to establish an updated city map, define a system to make it easier to locate places in a city where housing had developed in a totally disorganized fashion over previous decades and better identify the potential tax base.

Street addressing was also instrumental in developing an urban road maintenance programme for Conakry, as well as a solid waste management system (collection zones, transfer routes, billing).

Mali

In 1982, Mali launched its first addressing project as part of various reforms intended to strengthen its decentralized services. The first urban project mobilized resources from the District of Bamako for the District's State Land Inspectorate, responsible for reorganizing all land documents; and for the Departmental Tax Inspectorate, responsible for creating and implementing a street system and waste collection tax. The second urban project helped to set up a financial division in the District of Bamako, and to create a multi-purpose cartography unit (Carpol) for the future creation of a cadastre.

In 1992, the French Aid and Cooperation Fund (FAC) financed an addressing initiative as part of the Bamako District Support project (1992-97). That project created an addressing unit within the district's technical unit using Carpol resources for the project. The operation involved 2,600 streets, 60,000 entrances and 600 street signs. Then, in 1999, the third urban project led to the institution of an "urban fee", and addressing was expected to help identify the tax base. Five regional capitals implemented street-addressing initiatives: Gao, Kayes, Mopti, Ségou and Sikasso. In 2000, a new project, Urban Infrastructure Development Project (PACUM), financed addressing in Kayes.

Mauritania

Mauritania recently underwent decentralization intended mainly to "promote the exercise of democracy and local development initiatives by implementing participatory methods that promote sound management of the affairs of populations" (Government Municipal Policy Statement).

Since 1998, addressing has been an important tool in sound municipal management. With support from the French Ministry of Foreign Affairs, the French Agency for Development and the World Bank, addressing is now being expanded to all 12 regional capitals and even beyond. The broad geographic scope of the operation is mainly due to its tax applications. Addressing is expected to help consolidate procedures for issuing tax notices and collecting taxes handled by municipalities, and therefore to help with the organization of decentralized and deconcentrated departments in charge of these tasks. This objective has been the driving force behind efforts to implement the entire operation more rapidly. In addition, some local consulting firms have been mobilized to support municipalities in this task.

Mozambique

The addressing project was part of the Mozambican government's plan to decentralize the administration of its 33 largest cities. Municipalities had been rendered ineffective due to the impact of the civil war, a deteriorating economy, and the fact that large numbers of rural residents had migrated to cities, swelling unplanned urban neighbourhoods, which lack adequate facilities. In such a situation, with few available public resources, the Mozambican authorities wanted to create tools and procedures to help rebuild the capacities of urban institutions to better control the development and administration of cities. Addressing appeared to be the obvious first step in the entire process. Addressing for the city of Maputo was initiated in 1992, but not actually implemented until 1995. The success of this effort led to expansion of the project to four regional capitals (Beira, Nampula, Pemba and Quelimane), and to Matola.

There were many applications of the street-addressing initiative, notably the use of a street-addressing index and map to locate, confine and eventually eradicate cholera epidemics, and the use of the street-addressing database to compile a business directory in the city of Maputo (9,000 formal and informal operators).

Niger

Niamey was one of the last remaining capitals in the region without a street-addressing system. As this city of 800,000 inhabitants attempted to decentralize, proper street addressing became an urgent need. An addressing component was first conceived as part of the Urban Infrastructure Rehabilitation Project (PRIU), which financed a feasibility study in 2001. However, time constraints made the project unfeasible. Another donor, AIMF, already working on other projects in Niger, showed an interest in including addressing in its cooperation with the metropolitan government of Niamey (CUN). The objectives included the creation of an urban data bank, urban management tools and improvement of the CUN's resources.

Senegal

Street addressing was not implemented in any significant way in Senegal until 1998, with the Urban Development and Decentralization Programme (PAC) and the follow-up World Bank urban projects. Street addressing focused on 15 municipalities out of the 67 urban municipalities included in the programme. Municipalities carried out urban, organizational and financial audits, which led to a thorough diagnosis of their situation and a very pragmatic improvement programme (involving urban investments, as well as municipal capacity-building measures). Following a participatory process engaging community members and various stakeholders, the municipalities agreed to the terms of a municipal contract, signed with the central government, to carry out three

priority programmes for investment, maintenance and institutional strengthening.

The street-addressing component was very much part of the institutional strengthening programme. It had a dual objective: (i) to address the main cities in the country, and ultimately facilitate local tax collection; and (ii) to test, in two other cities, Thiès and Kaolack, an interface of tax rolls and the address directory to identify potential taxpayers, who had thus far escaped tax payment, leading to major improvement in tax revenue collection.

Street addressing methodology at a glance

Implementation of street addressing does not require highly specialized skills. A team of municipal technical managers, supervised by an ad hoc expert at key moments, is the best way to ensure ownership and sustainability of knowledge. The team should comprise three permanent members (team leader, cartographer and computer specialist), who can be supplemented with enforcement personnel to carry out field activities, as necessary.

There are three basic assumptions:

- Designating street names at the outset is nearly impossible and really not the key objective.
- Street-addressing programmes are a municipal undertaking.
- An address is defined by its relation to a street, rather than to a block of houses.

The methodology of a street-addressing programme is organized into 13 activities that flow from three phases: preparation, implementation and maintenance.

Activity 1:
Designing the street addressing programme

First, the **preparation phase** aims to define approaches for implementing the street-addressing programme and setting up the unit charged with coordination, known as the "street-addressing unit". Tasks during this phase will focus on:

- Conducting a feasibility study on the codification system for identifying streets and numbering doorways, as well as on approaches to implementing the programme;
- Setting up the street-addressing unit responsible for coordinating implementation.

The actors involved are the municipality, a consultant and the street-addressing unit. The expected results are approbation of feasibility study and launching of the street-addressing unit. Duration will be about 21 weeks, of which 12 are used for the feasibility study. Costs incurred will cover the feasibility study (two person-months) and the hiring of three people to head the unit.

With the **implementation phase** the programme becomes fully operational. Tasks will focus on:

- Preparing the address map and the street index (mapping);
- Positioning street signs at the main intersections (installation of signage);
- Numbering doorways, according to the codification system adopted and the survey associated with it;
- Setting up an address directory; and
- Conducting a media campaign for the street-addressing programme.

The actors involved are the municipality, the street-addressing unit, a trainer, survey takers and labourers, a media campaign specialist, a street sign manufacturer and installer, and a printer. Results will hinge on the undertaking of the tasks above and production of the following documents: address map, street index, address directory, media campaign components, signage map and list of street signs. Duration and cost will depend on the size of the city. The estimate is 12 to 18 months. Costs incurred will cover street-addressing unit operations, supply of street signs and materials needed for numbering doorways, and media campaign expenses.

The **maintenance phase** usually requires fewer resources than those needed for implementation. Tasks will focus essentially on the following issues:

- Updating and completing the numbering process: some doorway numbers will have disappeared, new doorways will have been created, and addresses need to be assigned to new districts;
- Updating and distributing the address directory;
- Updating and completing street sign installation: some street signs will have disappeared or have been damaged, new streets must be given signs;
- Updating the address map.

The actors involved are the municipality and the street-addressing unit. Results will consist of updated versions of existing documents and possibly the extension of street-addressing programmes to neighbourhoods that do not yet have addresses. Once the main street-addressing needs have been met, the street-addressing unit should expand its role using the knowledge gained from the street-addressing programme, and broaden its mandate to become a documentation centre, for example, or urban database. In terms of duration, maintenance should be conducted annually. Costs incurred will cover the operations of the street-addressing unit and possible supply of new street signs and materials for numbering doorways.

Activity 2:
Conducting a feasibility study

The design and implementation of a street-addressing programme must take into account local conditions and available financial resources, which are unique to each city. Municipal authorities must have data available for decision-making. Recommended guidelines should be prepared through a feasibility study, which should include:

- Codifying streets and doorways;
- Scope of the programme;
- Practical methods for mapping, numbering, surveying, sign installation, and creation of an address directory;
- Organizing and staging the programme;
- Cost, financing, deadlines.

Activity 3:
Setting up the street addressing unit

This stage involves two areas of responsibility: decision-making and implementation. Decision-making falls under the responsibility of municipal authorities, which undertake and finance the programme. They make critical decisions identified during the feasibility study. Other administrative entities and key entities should also be involved. Setting up a supervisory

Bujumbura, Burundi

committee is usually a good approach to broaden participation. Implementation requires a specific structure placed under municipal authority: the street-addressing unit. The unit's role may evolve from that of service provider during implementation to a permanent department during the maintenance phase.

The street-addressing unit will intervene in accordance with decisions resulting from the feasibility study. During project preparation, the unit's tasks include setting up the unit itself, collecting documentation and training unit staff.

The unit comprises a set of full-time core members and teams deployed on a short-term basis. A coordinator will manage the unit. The full-time core members are involved throughout the whole process. They include a coordinator, responsible for moving the work forward, someone in charge of mapping and placement of street signs, and someone in charge of taking surveys and creating the address directory. Short-term teams are involved in the implementation phase during survey taking and doorway numbering. To operate with efficiency, the unit needs some autonomy at the outset. The unit must have its own offices and technical and computer equipment.

Activity 4:
Estimating costs and time frames

The objective is to estimate the cost of a street-addressing programme and to design an intervention programme in which costs stay within the projected budget. Before any simulation is run, a preliminary inventory and mapping exercise will determine the scope of the programme. Several simulations are usually needed to reconcile estimated costs with the projected budget for the programme.

Four specific tables are prepared to calculate the global cost of the street-addressing programme:

- The first table focuses on basic cost calculation data;
- The second calculates the cost of street addressing, including: (i) staff expenses, (ii) unit operating expenses, (iii) unit equipment, (iv) supply and installation of addressing materials, (v) media campaign, and (vi) printing of address maps and index.
- The third table makes assumptions according to the size of the city (number of inhabitants and density); and
- The fourth table focuses on the implementation time frame according to the size of the city.

Activity 5:
Defining the scope of the programme

The objective is to define the scope of the street-addressing programme by comparing the resources available with coverage of planned activities. Three issues must be resolved: which neighbourhoods to prioritize to receive addresses; the coverage of the street-addressing programme; and the definition and location of the pilot operation.

The scope of the programme is evaluated and approved by the supervisory committee during the feasibility study (preparation phase), and then applied and shaped during the implementation phase.

Activity 6:
Choosing a codification system

Identifying streets and numbering doorways requires the adoption of a codification system. The expected result is improved navigation around the city through the aid of easily visible signage that identifies streets and building entrances. Assigning names as street identifiers is generally sensitive and lengthy: the preferable solution, initially, is to use a numbering system that will enable people to find familiar places or subdivisions.

During the course of the feasibility study, the consultant chooses a codification system, which is then subject to approval by the

supervisory committee. Implementation consists of five tasks:

- Divide the city into address zones;
- Decide on a system for identifying streets;
- Decide on a system for numbering streets;
- Decide on a system for numbering buildings; and
- Make adjustments for special cases.

Activity 7:
Mapping

The objective is to create an address map with a scale along the lines of 1:10,000, which shows streets and neighbourhoods, their toponymy, administrative boundaries and principal buildings. The resulting map together with street sign information will become the signage map.

The activity consists of six tasks:

- **Preparation phase:** (i) gather the documentation and (ii) confirm the level of staff expertise in cartography;
- **Implementation phase:** (iii) make the base map, (iv) inventory all streets, (v) prepare the address map, and (vi) prepare the signage map (see Activity 10).

Activity 8:
Surveying and numbering doorways

The objective is to number the doorways of buildings and, in the process, conduct a survey, the results of which will be recorded in the address directory. This is undoubtedly the most time-consuming and meticulous part of the street-addressing programme. A number of tasks must be carried out prior to the surveys and doorway numbering:

- (i) Approval of the codification system by the supervisory committee upon completion of the feasibility study;
- (ii) Definition and production of the base map;
- (iii) Reparation of questionnaires and surveying and numbering materials;
- (iv) Recruitment and training of surveying and numbering teams; and
- (v) Pilot operation.

Tasks (ii) to (iv) are performed at the start of the implementation phase.

Activity 9:
Recording addresses

Recording addresses includes two **objectives**: to set up an address directory based on the survey findings; and to make it available to government agencies and utility concessionaires, who will add supplementary information according to their own needs.

The expected results are a computer printout, generally in spreadsheet form, intended to facilitate the dissemination of information; and a data analysis document that provides information such as number of named or numbered streets, number of doorways per neighbourhood, list of business activities by neighbourhood, and so forth.

The implementation phase begins with the preparation of a data analysis code for the survey (Activity 8) and the development or procurement of system software. The data are recorded during the survey process. This phase consists of four tasks:

- Survey organization and checking;
- Coding;
- Data entry; and
- Analysis and follow-up.

Activity 10:
Installing street signs

The objective is to install signage on street corners to designate each street by name and/or number. The expected result is either the installation of street signs on building facades or posts, or the use of more rudimentary solutions. This decision is generally budget-driven. Owing to the diversity of tasks included under this activity, they should each be undertaken in expedited fashion without necessarily waiting until the surveys have been completed.

The following tasks are to be performed:

- Define the signage system,
- Prepare the maps and list of street signs,
- Procure the sign materials, and
- Install the signs.

Activity 11:
Producing the address map and street index

The objective is to print the address map and its index of streets and disseminate them to government offices and to the general public. This activity should accompany the media campaign to promote the street-addressing programme.

An address map is prepared for the surveys and for sign installation. The remaining tasks are as follows:

- Check and complete the map;
- Prepare the street index;
- Begin printing; and
- Disseminate and, if possible, sell the documents.

Activity 12:
Conducting a media campaign

It is essential to keep the public informed of progress and to explain the reason, substance and schedule of the street-addressing programme. A media campaign is vital for achieving this objective. The surveys, doorway numbering and sign installation will have a direct effect on city residents, and these innovations will undoubtedly generate many questions and comments. The absence of relevant information could lead to misunderstanding or unfounded resistance to such a programme.

The municipal authorities are responsible for the media campaign with the assistance of the addressing unit, but a specialized agency has to be hired for this specific task. The cost could be about 3%–5% of the operating cost. The media campaign should be targeted to municipal authorities, government departments, economic operators, neighbourhood leaders and civil society. The media campaign may include meetings, seminars, radio and television interviews, leaflets, maps and indices, films, and so on, all launched with an official stamp of approval.

Activity 13:
Maintaining and adapting the system

Implementing a street-addressing programme in a city is an ongoing operation, especially if the urban area is continually developing. Without maintenance, the system will quickly become obsolete. The objective of this activity is to maintain the system once it has been established. The expected result is the identification of ways in which the street-addressing unit, in particular, can help to achieve that objective through its intervention plan after the initial addressing operation.

The importance of maintaining the system is generally well understood, but the means of

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Settlement of Alaska, Mamelodi East, Pretoria, South Africa

achieving this objective are often left unspecified. Therefore, an action plan and budget will need to be prepared and approved by the municipal authorities. The best way to ensure maintenance is to integrate the street addressing unit as a new service inside the municipal administration.

Scaling up capacity development: e-learning

The World Bank (WBI Urban Practice) is currently developing a curriculum of e-learning courses, including one on urban planning and land management, devoted to sustainable land use planning and street addressing. The street addressing course programme is made up of four main modules and is based on the four chapters of the book "*Street Addressing and the Management of Cities*". The intent is to work with cohorts of municipal staff in order to ensure a critical mass and a momentum for action, as well as to work with municipalities that have engaged or are ready to engage in street addressing programmes.

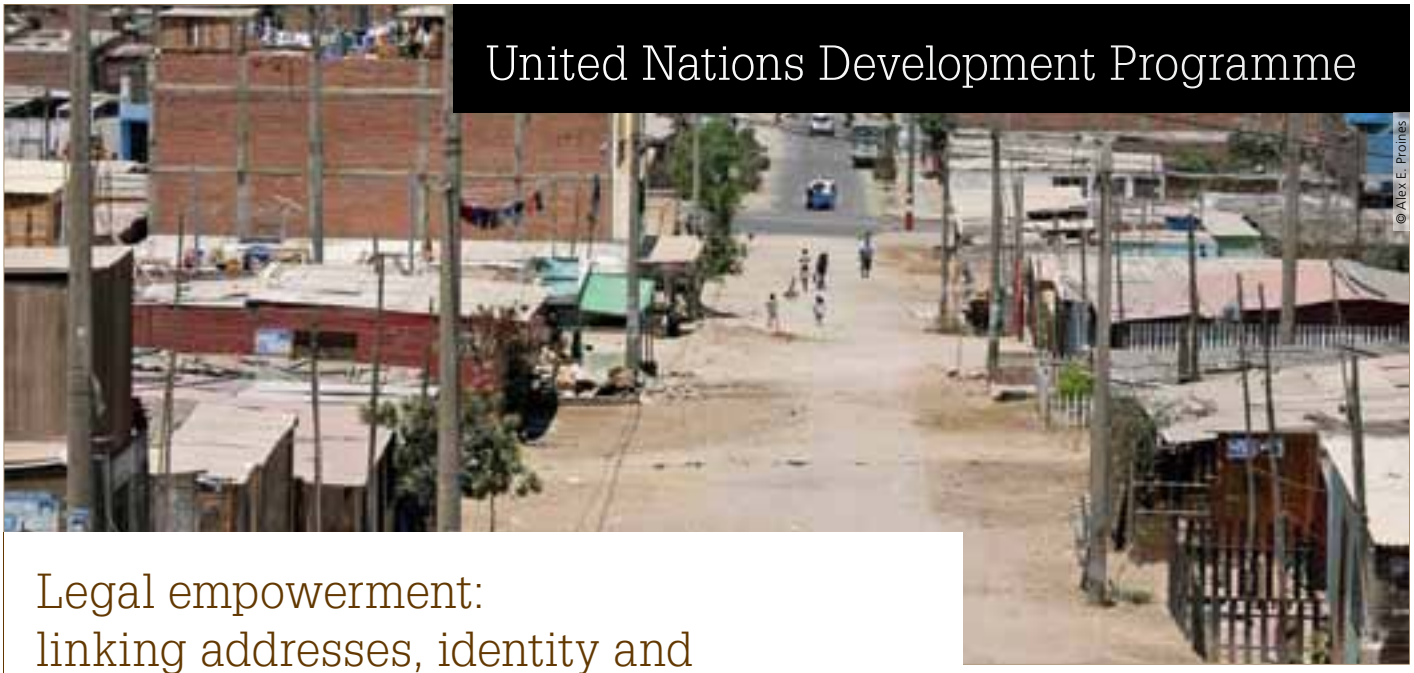
Future trends and perspectives

In today's challenging context of rapid urbanization, the role of local governments becomes even more important to support economic growth and reduce poverty. In recent decades, street addressing has experienced a revival as more municipalities and a growing number of beneficiaries realize its potential. The case studies described above demonstrate how addressing has been used successfully to support the management of cities, bringing benefits such as better epidemic detection, more effective tax collection and improved means of locating businesses. By providing baseline information, addresses serve as an important management tool across many different policies and help local governments to make informed policy decisions.

In practical terms, addressing projects allow for a comparatively short implementation period and few resources and are a way for municipalities to step forward and take the initiative to manage their cities. As we have seen, this is fundamental in the context of rapid urbanization. However, although addressing projects may be feasible technically and financially, political commitment remains an essential factor for their success. In this vein, the World Bank contributes to global knowledge through its e-learning course and financial support to various addressing programmes. These activities aim to train municipal practitioners on the use of the methodology, and to connect those practitioners to each other. Nevertheless, local addressing initiatives can be successful only if they form part of a countrywide strategy. Addressing must be embraced nationally in order to achieve an inclusive and informative system able to support a country's development goals.

At the international level, the UPU's "Addressing the World" initiative offers an opportunity to synchronize efforts, creating awareness around the value of addressing, and providing a platform for a broader constituency, to put citizens on the map locally, nationally and internationally.

1) Maputo, Conakry, Douala, Bamako, Lomé, Niamey, Yaoundé, Nouakchott, N'djaména, Thiès, Kaolack, Ouagadougou, Beira, Matola, Bobo-Dioulasso, Nampula, Zinguinchor, Quelimane, Diourbel, Louga and Pemba.



Kids on Main Street, Peru

United Nations Development Programme

Legal empowerment: linking addresses, identity and land and property rights

The interrelation of addresses, law and development is not a widely analyzed topic. Addresses are, however, closely linked to the protection of the rule of law, in particular to legal identity and land and property rights. Individuals, families and communities without solid land and property rights are often the same households and communities that lack a formally recognized addressing system and recognized legal identity. Some informal settlements develop their own system of identifying houses and naming streets, but without official recognition such systems do not provide the certainty and access to services brought by addresses. The development approach of legal empowerment places emphasis on guaranteeing legal identity and land and property rights, and ensuring the voice of the poor in their own development. These concepts of legal identity, legal rights and voice are very much dependent on the existence of an addressing system.

The United Nations Development Programme (UNDP) is the United Nation's global development network. The UNDP works with 177 countries on their own solutions to global and national development challenges. A key pillar of the UNDP's engagement is its partnership with countries to develop institutions and processes that are more responsive to the needs of ordinary citizens, including the poor, and that promote human development. In this way, the UNDP works to make real improvements in people's lives and in the choices and opportunities open to them, including through legal empowerment approaches.

What is legal empowerment?

Legal empowerment is an approach to human development which recognizes that poverty results from disempowerment and exclusion. The approach contributes to development outcomes through institutional and legal reform that aim to empower individuals and communities to become agents of their own development. Those involved are able to strengthen their livelihoods through enhanced awareness of their rights in all areas (education, health, employment, voting, etc.) and by accessing legal protection and remedies where those rights have been violated.

The independent, high-level Commission on Legal Empowerment of the Poor, co-chaired by Madeleine Albright, former U.S. Secretary of State, and Hernando de Soto, President of the Institute for Liberty and Democracy, was launched in 2005. The Commission's final report, "Making the Law Work for Everyone", stressed that legal empowerment is "a process of systemic change through which the poor and excluded become able to use the law, the legal system and legal services to protect and

advance their rights and interests" (UNDP, 2008). The United Nations General Assembly (UNGA) endorsed the Commission's report and the UN Secretary-General, in his 2009 report to the UNGA on the legal empowerment of the poor (A/64/133), urged the UN system to "address in more detail the issues of rights, including labour rights, property rights, as well as other rights essential for the livelihoods of the poor".

The Commission highlighted the fact that the poor lack the opportunity to improve their lives because they do not enjoy the protection of the rule of law. Such situations are due to an absence of laws, a lack of enforcement of existing laws, or the fact that laws are discriminatory, dysfunctional or irrelevant and serve as barriers to legal empowerment.

Legal disempowerment and exclusion from the rule of law are important dimensions of vulnerability to exploitation and cycles of poverty and violence. When people are unaware of their basic rights or unable to exercise them, they are more likely to face physical, financial and social barriers to human development. Legal empowerment emphasizes the importance of legal identity in overcoming these barriers, and bringing all people to a situation where they are formally recognized by the law.

Legal identity

"Name", "address" and "profession" are the three most common forms of legal identification; however, these remain out of reach for the majority of the world's poor (UNDP, 2007). An estimated 4 billion people identified by the Commission on Legal Empowerment of the Poor live outside the protection of the law, and as such have no legal identity recognized by state institutions. In studies conducted in 20 countries since 1998, the Institute for Liberty and Democracy estimated that between 70% and 90% of urban and rural populations were "extralegal". Legal identity – and, as part of this, the prerequisite of formal addresses – is the basis for bringing communities under the recognition and protection of the law. The Commission also recognized legal identity as a fundamental factor in access to justice. As one member of the Commission's Working Group on Access to Justice, Matthew Stephenson, put it, "a legal identity is the keystone to legal empowerment. With it, you can be immunized, go to university, own property and an address, vote, work legally, open a bank account, bring a case to court – the state recognizes that you exist" (UNDP, 2007).

Slum in Port-au-Prince, Haiti

Legal identity refers to the registration of birth, nationality and other personal identifiers, such as fingerprints and eye colour. This registration often produces identity documents, which serve as proof of the formally recognized and registered status of the person's identity. These documents can take many forms. Some jurisdictions have an identity card issued by the state, and in many countries a birth certificate is a common form of identification. Other documents used to confirm identity, such as passports and driver's licences, usually require a birth certificate or other government-registered document to be produced on application.

Legal identity and crisis

Conflict and crisis situations where large numbers of persons are displaced or seek refuge often bring into stark relief the importance of legal identity. Large numbers of displaced persons depend on assistance to meet their basic needs in the early recovery stages, but conflict and crisis situations often lead to the loss of identity papers that provide affected people with the necessary legal status to access basic services or to claim compensation and property. Thus, re-establishment of identity and restoration of legal records are critical in order to obtain international assistance and prevent further social marginalization and distress. In the aftermath of the floods in Pakistan of September 2010, for example, parts of southern Pakistan remained under water for months. Across these areas, hundreds of affected persons used the services of UNDP mobile facilities, which issue and replace identity papers and other documents necessary for claims for medium and long-term assistance.

Following the earthquake in Haiti in 2010, large numbers of displaced persons lacked or had lost identity documents. UNHCR reported that the majority of people issued identity cards were women who had lost their partners and become solely responsible for raising a family. Some had given birth in displaced persons camps. Without proof of citizenship, children might not be able to attend school or access medical care. They might also be vulnerable to exploitation and human trafficking. UN agencies worked with Haiti's Ministry of Justice and local NGOs to establish and expand a registration project with a view to developing a comprehensive registration process. (UNHCR 2011)

While it might seem like a largely administrative process, the value of legal identity can be far-reaching, both in practical and symbolic terms. State recognition of a person's identity is the first step in establishing the state–citizen relationship, and it underpins processes of political participation such as voting and standing for office (Boekle and Harbitz, 2009). Lloyd Axworthy, former Foreign Minister of Canada and former Chair of the Working Group on Access to Justice, describing his visit to Peru in 2006 to observe the presidential vote, stated: "President Alejandro Toledo told me that there are a million Peruvians who don't 'exist'" (UNDP, 2007).

The importance of legal identity for democratic governance is also recognized in the international human rights framework

developed under UN auspices. Article 15 of the Universal Declaration of Human Rights states that "everyone has the right to a nationality", a concept elaborated on in the International Covenant on Civil and Political Rights (ICCPR), which stipulates that every person be registered after birth. Similarly, the Convention on the Rights of the Child lays out that every child "shall be registered immediately after birth" (Article 7).

Nonetheless, birth registration is often the first barrier to establishing legal identity. UNICEF estimates that every year 48 million children are not registered at birth. In many countries, registration can be a costly and time-consuming process involving a cumbersome bureaucracy and poorly managed records. For example, a survey of women in Latin America highlighted that 10% of them did not register their children because the local office lacked the proper stationery (UNDP, 2007). Many children who are not registered at birth, and who therefore lack a legal identity, are likely to experience substantial barriers to their development as they grow older. Legal identity represents state recognition that the individual belongs within the formal sphere of the state's protection and is entitled to certain services and rights. Without legal identity, individuals and communities are more likely to be exploited in unregistered work, lack access to services and be unable to participate in democratic governance mechanisms. They are less able to travel or migrate without identity documents, and they risk becoming stateless without the acknowledgement of citizenship. Legal identity is linked to marginalization and discrimination, perpetuating the exclusion of particular groups from legal protection. Vulnerable communities such as displaced persons, dwellers in informal settlements and minority groups are more likely to live without documentation of legal identity.

Economic, social and cultural rights

Addresses are often required to receive public services that ensure the enjoyment of economic and social rights. These rights, such as the right to education and the right to health, are enshrined in the International Covenant on Economic, Social and Cultural Rights (ICESCR). The Covenant adopts the principle of progressive realization, acknowledging that realizing these rights will require time. Progressive realization does not allow, however, for discrimination against individuals or groups in the gradual fulfilment of these rights. Yet communities can be vulnerable to discrimination if they lack a legal identity. For example, Article 9 of the Covenant recognizes the right of everyone to social security, including social insurance, and sets out that the benefits of these schemes must be accessible to all and provided without discrimination. Often, however, a formally recognized address is required for individuals to benefit from social insurance schemes. Without identities or addresses, communities in informal settlements or rural areas must operate outside these social insurance protections, making them vulnerable to exploitation.

Legal identity brings with it access to fundamental services, for which proof of identity is often a prerequisite. Such services can include education, health and social welfare, as well as services provided by the private sector, for example, bank accounts, consumer credit and telecommunications (mobile phone contracts).

The link between poverty reduction and legal identity was established in an econometric study on civil registration of births in Bolivia, Brazil, Colombia, Nicaragua and Peru, where children and adults without legal identity were found to be denied access to health, education, housing, nutrition and other benefits arising from poverty reduction policies. Those living in poorer socio-economic conditions were less likely to be registered from birth to age 5 (Duryea, Oligati and Stone, 2006). Addresses are an integral part of the baseline information needed to issue personal identification; therefore, a formal infrastructure of addresses is required to provide all individuals with the opportunity to obtain legal identity.

Land and property rights for poverty reduction

The linkages between legal and governance systems and poverty reduction are particularly stark in the field of land governance, land rights and property rights. In 2000, 189 nations committed to free people from extreme poverty and multiple deprivations in the Millennium Declaration, on the basis of which the Millennium Development Goals (MDGs) were formulated. These eight goals range from the provision of universal primary education, to the reduction of child and maternal mortality, and are accompanied by measurable targets and clear deadlines for overcoming extreme poverty. Of the eight Millennium Development Goals, which represent the internationally agreed targets for human development, three hinge on access to land and tenure security: reduction of poverty and hunger, gender equality and environmental sustainability. Land and tenure security also has an impact on the achievement of two other MDGs – universal primary education and the combating of HIV and other diseases (Rashid, 2010).

Land governance systems are complex and are composed of diverse mechanisms that vary widely across countries and jurisdictions. In some countries, a communal land title is recognized, perhaps under customary (or traditional) law mechanisms. Customary law can also govern the recognition of land and property rights, such as with inheritance. In some jurisdictions, land-use rights are recognized for activities such as farming, gathering and fishing. Certain jurisdictions have national land registration mechanisms, while in others local authorities play a key role in overseeing land rights, boundary disputes and other land-related issues. These structures need not be formal state-based systems; customary law can operate through informal systems. The important issue is not the form of the mechanisms that regulate land and property, but rather whether the systems provide protection for land and property rights, security of those rights, and access to a remedy where those rights have been violated.

Despite the existence of various land governance mechanisms, the majority of the world's inhabitants live without secure land and property rights (UNDP, 2008), from subsistence farmers to shack dwellers, making them vulnerable to eviction, exploitation and land invasion. In contrast, a secure system of land and property rights can:

- Eliminate or reduce the risk of expropriation and, within the context of increased security, foster investment in the land and production, contributing to economic benefits;
- Reduce transaction costs and other costs incurred to defend land and

Nakuru, Kenya

property rights, including reduced vulnerability to extortion by criminal elements in informal settlements;
- Allow for fungibility of assets, including access to credit, if appropriate (Besley and Ghatak, 2009; Rashid, 2010).

One of the many benefits that better land and property rights can yield is reduction of poverty and hunger. Currently, 75% of the world's poor living in rural communities depend on agriculture for their livelihood (World Bank, 2007). Secure land tenure can support longer-term investment in production, leading to increased agricultural productivity, and expanded and more secure employment opportunities. As food prices and energy prices continue to rise, land management is emerging as a critical factor in enhancing and sustaining global food security.

Land and property rights also aid in strengthening gender equality. Women are often especially vulnerable to discrimination, eviction and land grabbing from neighbours, family members or community leaders. Both customary law and decisions of formal justice systems can be applied in a discriminatory manner in relation to women's land ownership and their rights to land through inheritance. With regard to inheritance, women without a husband or male guardian often face loss of livelihood and shelter where they are prohibited from inheriting land by law or practice. The Centre on Housing Rights and Evictions conducted surveys on women and inheritance rights in 10 sub-Saharan countries. The survey revealed linkages between access to land and situations forcing women into transactional sex for survival, increasing their vulnerability to HIV (Centre on Housing Rights and Evictions, 2004). Women who try to claim their land also risk violence perpetrated by family members or others competing over the land. Awareness of their rights and access to justice and legal protection thus empower women, making them less vulnerable to these threats and strengthening their rights to land.

Women are also key stakeholders in ensuring environmentally sustainable practices. In rural areas, they are the ones usually responsible for obtaining food, fuel, wood and so forth, to ensure the survival of their families. The consequences of climate change, such as increased periods of drought, major flooding and forest degradation, make it more difficult to gather food and fulfil other survival needs. Women are also frequently responsible for saving and managing seeds. Granting women full and equal inheritance and property rights increases their interest in the sustainable use of land, builds their role in ensuring environmental sustainability and draws on their experience in managing the local environment (Berg, Horan and Patel, 2010).

Moreover, effective land management can play a role in environmental sustainability by integrating poverty-reduction and environmental policies. Not only does a well-functioning and responsive land governance system ensure sustainable use of land and natural resources, but it also establishes a framework for facilitating equal access to mitigation and adaptation policies. Through the establishment of an officially recognized system of land rights, vulnerable groups can obtain security and certainty in their rights to seek mitigation and compensation for harmful environmental impacts. In this sense, land rights can be a critical factor in responding to the challenges of climate change mitigation and adaptation.

Addresses as the enabler of land and property rights

In order to ensure responsive land governance systems, identifiers are required to indicate where the land or property is located. For everyday purposes, addresses play this role, removing the need for land title or record searches to identify a person's place of residence. Without an address recognized by a land governance mechanism, habitants are more vulnerable to eviction. This is particularly relevant for informal urban settlements.

Although an informal system of numbering or other identification system may exist, without formally recognized addresses and property rights, settlements have difficulty accessing water and electricity and have no protection when exploited or evicted by landlords or criminal gangs. They are equally vulnerable to eviction by private developers or government officials.

The significance of recognition of land and property rights extends well beyond economic benefits. Property and land not only shelter individuals and communities, they also provide a symbolic connection to a location, and their ownership feeds into human dignity. The linkage between property and human dignity is enshrined in the International Covenant on Economic, Social and Cultural Rights, which states that economic and social rights derive from the inherent dignity of human beings. This right is also enshrined in Article 17 of the Universal Declaration of Human Rights: "(1) Everyone has the right to own property alone as well as in association with others. (2) No one shall be arbitrarily deprived of his property."

An understanding of land and property in human rights terms assists in situating land governance as part of a broader system that extends beyond legal instruments and institutions dealing with land. A fundamental aspect of the human rights approach is the perspective that rights should be recognized and respected not only by formal institutions, but also at a community level. More than simply a matter of the legal recognition of a right, this also involves social and community acceptance of the land and property right (Rashid, 2010). In this perspective, addresses are an important tool enabling social, community and government recognition of a land or property right, as they help to ensure that the poor are included and accepted into the broader community systems.

Legal empowerment is an approach to development mindful of the importance to individuals and communities of participating in the processes and institutions that affect their lives, and which supports institutions that are responsive to the needs of those individuals and communities. Legal empowerment is not just about establishing a prescribed set of institutions in each context; rather, it looks at the interactions between the poor and those institutions in order to respond to the constraints on human development (Rashid, 2010). For example, it recognizes that, while legal frameworks and institutions might be established for land title registration, several factors may still discourage people from obtaining titles. The registration and titling process might be procedurally cumbersome, costly and available only in formal courts, whereas the local community may prefer informal adjudicatory systems.

Land and legal empowerment in the Ukraine

Changes in legal frameworks and lack of legal knowledge and awareness hamper the enjoyment of property rights among the rural population of Ukraine, especially the disadvantaged. The legal literacy of the population and the weak capacity of legal service providers are key factors in this disempowerment: rural populations do not know what rights they have or how to access protection and remedy where their rights have been violated.

In July 2011, the UNDP and the Ministry of Justice of Ukraine jointly launched a project to legally empower the rural population. Community-based literacy campaigns on the property rights of farmers and landowners were organized to provide sufficient knowledge and understanding of property and land rights. Actions were also taken to develop capacity among state legal aid providers. The project, "Fostering Full Enjoyment of Land and Property Rights", is engaging with free legal aid centres of the Ministry of Justice, civil society networks, think tanks, community-based organizations and the media.

Without awareness of the legal mechanisms available to them, the poor are increasingly vulnerable to landlessness without justifiable cause and without adequate compensation. The Centre on Housing Rights and Evictions documented that forced evictions – for the most part characterized by violence and a lack of legal remedy, protection or compensation – resulted in the loss of livelihoods for the poorest and most marginalized (Centre on Housing Rights and Evictions, 2010). Empowering the poor by providing them with a voice and identity to engage with government and formal institutions is part of ensuring that land policies stem from inclusive and deliberative processes. This approach will help to promote land access, enhance the security of land rights and prevent arbitrary land takeover (Land Tenure and Development Technical Committee, 2009).

Conclusion

Approaches centred on legal empowerment of the poor aid in the expansion of the poor's access to legal and institutional mechanisms from which they have traditionally been excluded. Such approaches emphasize the critical nature of legal identity, land and property rights, and poverty reduction as vehicles to help the poor break the vicious cycle of exclusion and poverty.

Addresses underpin these key priorities in the legal empowerment approach to development. They sit at the interface linking individuals to legal identity and to their property and land, thus helping to support empowerment. Addresses form part of the fundamental information necessary to obtain legal identity, and are a prerequisite for access to services and political participation. They also embody a symbolic recognition by the state, society and/or community of the individual's existence, rights and sense of belonging. Addresses link legal identity and land, ensuring formal institutional and symbolic community recognition of an individual's connection to a certain piece of land or property. Addresses empower individuals to further their livelihood and human potential.

International Telecommunication Union

Village of Beilin, China

Linkage between virtual and physical addresses

Somewhere in England, someone picks up a mobile telephone to call someone on a landline in China. They tap out a few digits, and within a few seconds, a single telephone on the other side of the world rings. With more than 1.2 billion fixed lines in the world, and a further 5.4 billion active mobile cellular subscriptions, the challenge involved in assigning numbers to them all is immense. This is just one of the activities of the International Telecommunication Union (ITU) that ensure the smooth functioning of today's networked world.

Until relatively recently, it was possible to easily map a telephone number to a physical location. A fixed landline telephone number was associated with one physical address, and when a person dialled it, the telephone network operator knew exactly where the call was being routed. Then the telephone network evolved, and the numbering system it used effectively became a system of logical names. These have no location, unlike physical addresses. For example, the numbers assigned to mobile telephones are assigned to physical handsets, which are designed to move around, even between countries. These numbers serve as the device's logical name, which identifies it and moves with it, and, in contrast to a fixed line, do not inherently reveal its location.

As these numbering systems evolve, and the devices that connect them merge together, a new challenge arises: the changing relationship between physical addresses and logical names. This is also relevant in the emergence of Internet Protocol (IP) addresses and new networks and technologies. New, vital tasks include responding to these identification needs and managing the standards for hugely scalable systems at a global level to ensure that they enable everything to run smoothly. This is the role of the ITU. The ITU believes that the ability to communicate is a fundamental right, and that these activities contribute to our commitment to connect the entire world's population, regardless of location or income.

Telephone networks

The modern telephone network could not work without the numbering system. In the early nineteenth century calls between nations were still rare and could be routed by manual operators. But as the world became more global and more phones appeared, the manual processing of calls became unwieldy. The ITU responded by introducing a system to which everyone subscribed. The ITU's original numbering system allowed for telephone numbers with 12 digits. Under this numbering plan, countries agreed to adhere to a system of internationally assigned country codes, with national area codes established internally.

In 1964, when the first CCITT Blue Book to contain international dialling codes was launched, mobile phones were the stuff of science fiction. Nowadays, there are nearly four times as many mobile phones as there are fixed landlines, as a result of the huge growth of mobile phone networks in the developing world. Fortunately, ITU's experience in managing the smooth introduction and upgrading of fixed telephone numbering systems has helped it to manage these new technological developments.

The challenges inherent in mobile phone numbering are different and more nuanced than those facing fixed-line numbering systems. The Global System for Mobile Communications (GSM) network is the most complex part of the mobile numbering system, because of the roaming and billing issues involved. With the GSM network, the SIM card associated with each account has a number that identifies the operator. When roaming, a request is made to the SIM card for the five-digit number on the mobile phone, to enable it to identify the operator. That number is then used to verify whether a roaming agreement exists, and to relay information about the call back to the original operator, adding a layer of complexity to the system.

In many cases, a mobile phone operator may require a physical address for a subscription contract. In such cases, a telephone number can then be linked to the location of the user, even as she or he moves around. This address can provide operators with additional information about clients and can improve communication and exchange for payment or service delivery. Although prepaid mobile phone services, obtained through pay-as-you-go cards, do not always require an address, this is increasingly becoming a prerequisite. This is especially true in the developed world, where address verification can serve as an additional security measure or a means of improving service quality.

Comparing telephones to the Internet

In addition to managing telephone numbering systems, the ITU is also responsible for the management of numbers affiliated with IP addresses and domain names, which in one way or another serve as a type of address identification.

An IP address is the numerical address used to identify an Internet-connected device on the worldwide digital network. It serves two principal functions: host or network interface identification and location addressing. IP addresses are composed of long numbers whose format and use are defined under Recommendations ITU-T E.212 and ITU-T Q.708. A more recognizable form of identification on the Internet is the domain name. Domain names are composed of a finite arrangement of symbols, which provide easily memorizable names for numerically addressed Internet resources. The guidelines covering domain names are found under Recommendation ITU-T E.164.

While the process of expanding telephone numbers went smoothly, the expansion of IP addresses and the use of domain names ran into difficulty. The original addressing system used for the modern Internet, known as IPv4, ran out of numbers in February 2011, and a new system, IPv6, was created to extend IP address space on the Internet more or less indefinitely. Despite the creation of the new system, however, the ongoing transition from IPv4 to IPv6 has been painful and expensive, and is taking time to implement.

Complications also exist with regard to the ownership of Internet domain names. Because most organizations focus on global domain names (such as .com) rather than country-specific ones, many problems emerge concerning ownership. For example, companies can purchase a .com address in seconds with a credit card and an Internet connection, but the subsequent legal disputes over domain name ownership can last for years.

Attempts to search for e-mail addresses can also provoke difficulties. E-mail addresses today are extremely diverse as a result of the absence of any standardized system for formatting names. Current formats vary immensely: individuals may employ either or both names or none; they might use initials, dashes, or terms completely unrelated to their actual name. The possibilities are endless.

Unlike physical addresses, which serve to identify one location and specific individuals, the identification of devices or applications depends on logical naming and is not tied to a specific location. One benefit of a logical name is that it remains unchanged, even when a person changes his or her physical address. Telephone numbers, IP addresses and Internet domain names all serve this function. However, there are still challenges with regard to these types of identification; in particular, these forms of identification do not allow others to reach a person or location or to deliver physical goods and services. Online identities not tied to an address (e.g. a Gmail, Hotmail or Yahoo! e-mail address) require a link with a location-based physical address in order to establish physical communication and the delivery of physical goods.

Some countries have introduced services to verify e-mail addresses against a specific physical address in order to tie them to a particular user and residence. These services have emerged in the wake of e-mail and the Internet as a bolt-on designed to solve an inherent design problem: the Internet's inception as a largely private network in the US military and its later use among the academic system did not take into account fundamental issues, such as security. Even though physical addresses may not play a role in the logical naming or identification of new technologies, they are considered by some governments and organizations to be a valuable means of supporting cybersecurity, especially in the wake of e-government and e-commerce initiatives.

The ITU and ubiquitous networks

For several years now, the telephone system, the Internet, and other devices ranging from automobiles to household appliances have become increasingly interconnected, communicating over single networks that require standardization and effective governance. These devices join over ubiquitous networks that link a variety of devices and allow digital data to be exchanged seamlessly. The ITU plays an increasingly important role in creating standards for these converged, ubiquitous networks, known as next-generation networks (NGNs).

One challenge the ITU has identified is the need to separate logical names and physical addresses in the specifications for NGNs. One potential way to do this is by using identifications (IDs) to refer to certain devices or applications and then to separate locators to refer to locations. The IDs could then be mapped to the locators. This mapping could be achieved

using an identity layer, which would become a new part of the addressing architecture.

The increasingly complex relationship between logical names and physical addresses is likely to be more fully resolved as future networking systems are conceived. In the future, devices will be designed and fitted to communicate with other devices via a ubiquitous network. One particularly significant development within the ubiquitous network involves machine-to-machine (M2M) communications. Much M2M communication today uses mobile network infrastructure, because it is readily available. For example, if a car were to detect a flaw, it could use a mobile connection to dial the nearest auto shop centre and request a new part, then supply directions to the mechanic. For this to happen, the car would need to communicate with various devices, including a GPS tool, which would be able to provide a map showing the physical location of the nearest auto shop. In this case, physical addresses provide additional information that supports the smooth functioning of the system and the transformation from the virtual to the physical. Research into projects such as these is already underway.

The Internet of Things

The concepts of NGNs and M2M communication are being crafted in the context of a broader development: what technology experts call the "Internet of Things". The Internet of Things will be a vast, interconnected network of devices, large and small, that can communicate with – and in some cases control – each other. By its very nature, the Internet of Things includes M2M communication and touches many different disciplines, thus requiring coordination between different study groups and with various standards developing organizations.

The ITU has an Internet of Things Global Standards Initiative, which enables experts to meet and conduct standards-based development work. One such group is the ITU-T Study Group 2, which focuses on numbering, naming and addressing, all of which constitute a huge challenge. Numbering, naming and addressing will enable "things" to communicate with each other across the vast fabric of the Internet (or whichever network succeeds it). These processes are likely to provide users with information about a device's physical location in addition to its other properties.

An identification scheme is probably the biggest challenge of the Internet of Things. The Internet of Things will contain billions of objects that must be uniquely identified; this is a challenge that standards bodies must meet. So far, there is no internationally agreed solution. Some schemes for identifying objects exist, but these mostly respond to the problems of specific applications. One idea is to identify devices on the Internet through entities that the ITU calls "tags". These tags can be read by other devices and will communicate the ID of the device according to specific protocols. In an NGN that separates identifier from locator, one optional connection could be to use the tag-based ID of a device to identify its location.

Interoperability

One of the biggest issues in identity management today is that identifiers used in one network might not be understandable or usable in another. In the Internet of Things, people will want to use devices across multiple kinds of networks, and that involves linking the identities between things.

The solution may not involve a single global identity for a device on a network. Instead, a diverse collection of identities, as exists today, may prevail. For example, in some domains an identity is just an e-mail address. In others, such as social networks, an identity is far more complex, and much more loaded. It may include a real name, and links to other people. Some identities may include location-based information (such as those used for delivering goods or those employed in e-government applications). Mapping identities like these together and making them interoperable, while considering all of the privacy and security implications, will be a key part of the challenge.

Linking a physical device to an identifier is one problem, but linking that device to a specific physical address will be an interesting feat. Location information is one only facet of a device's existence. Some of the billions of objects connected to the network might identify a person's location, while others may not. The management of location information is more nuanced and will become an increasingly important task in the coming years.

Enlisting the help of others

The ITU is adopting a highly inclusive approach to tackling these new challenges to object identification, coordinating with actors worldwide to ensure that the largest number of stakeholders are heard. Organizations such as the European Telecommunications Standards Institute (ETSI), the Telecommunications Industry Association (TIA), the GSC Machine-to-Machine Standardization Task Force (MSTF), the Open Geospatial Consortium (OGC), the Global ICT Standardization Forum for India (GISFI), the GS1 and various sub-committees of ISO/IEC JTC 1 are involved, as is the Internet Engineering Task Force (IETF). The ITU also works with several focus groups that facilitate discussions between experts worldwide, who, while not ITU members, bring domain-specific expertise. The ITU's cooperation with diverse groups is crucial, especially with regard to the production of standards that everyone will be willing and able to adopt.

At present, it is unknown what role physical addresses will play in the future or what form they will take. However, in a world of untethered logical identities, such addresses can help to advance the ITU's goal of inclusive and safe networks – supporting communication worldwide. What is certain is that the move towards ubiquitous networks will require ubiquitous acceptance, and a willingness to collaborate across different domains to respond to the complexity of these changes.

Signage of Paris, France

Standardization guidelines for national address infrastructures, based on ISO 19160, *Addressing*

Traditionally, people have used addresses to direct themselves to buildings and their occupants. However, the advent of computers has opened up a whole new range of possibilities, including routeing and vehicle navigation, automated processing of mail items, utility planning and maintenance, spatial demographic analysis and geo-marketing. The result has been renewed interest in and demand for addressing standards that facilitate interoperability.

A **national address infrastructure** refers to the systems, facilities and organizational structures that support the efficient use of addresses within a country. Various stakeholders are involved in both designing and maintaining a national address infrastructure. These include town planners, city managers, utility companies, postal operators and the addressees themselves. These stakeholders either:

- Assign the address (e.g. local governments, postal operators);
- Use the address in a variety of ways (e.g. service providers, business partners, local governments and election commissions); or
- Find the address (e.g. citizens, emergency response teams and other service providers).

An **address assignment scheme** identifies the components that make up an address and describes how values are assigned to these components. These schemes vary in different parts of the world. In many European countries, reference to a road network in the address is common, while addresses in Asian countries commonly comprise a hierarchy of administrative areas without reference to a thoroughfare. In informal settlements, addresses can be unstructured, variable and creative.

Addresses play a key role in society, the economy and governance. The standardization of addresses (i.e. the scheme according to which addresses are assigned) improves the efficiency of their usage across sectors (Coetzee, et al., 2008). On this basis, the International Organization for Standardization (ISO) has undertaken a project, ISO 19160, *Addressing*, which aims to bring together stakeholders to develop a suite of international standards for addressing.

The diverse address assignment schemes used in different parts of the world reflect the local and cultural characteristic of addresses: no single scheme suits all countries; rather, each country has to design and implement an address assignment scheme that fits its citizens and systems. The standard for the address assignment scheme has to form part of national address infrastructure and

cannot be imposed internationally. However, international standards can provide guidance for the development of a standard. Addresses also need to be interoperable: software from multiple vendors should be able to process the same addresses; conversely, software from one vendor should be able to process addresses from multiple countries.

This chapter provides an overview of the ISO 19160 project and its recommendations. It discusses standardization requirements for a national address infrastructure, based on the work in ISO 19160. Moreover, it looks at design considerations for the development of a national address assignment scheme and concludes with a list of standardization requirements for such a scheme.

An overview of ISO 19160, *Addressing*

The first phase of the ISO 19160, *Addressing* project was completed in July 2011. It served to enable formal collaboration among stakeholders and had two objectives:

- Investigate and formulate requirements in relation to addressing.
- Make recommendations on whether standards should be developed and, if so, how this should be done.

The objective of this phase was not to design an address standard, but rather to review existing address standards in order to identify international addressing standardization requirements and to make recommendations on how these should be developed.

In the run-up to the ISO 19160 project, a workshop was organized in May 2008 in Copenhagen, Denmark, to consider the issues related to an international address standard (Coetzee, Cooper and Lind, 2008). The workshop brought together addressing stakeholders from around the world to present and discuss their perspectives on the standard. As a result of the workshop, as well as collaboration on other initiatives such as the "Addressing the world – An address for everyone" initiative of the Universal Postal Union (UPU), the majority of stakeholders agreed to participate in the ISO 19160 project.

In order to achieve the first objective, the ISO 19160 project reviewed a number of existing national and international address standards. This approach enabled the project team to identify requirements not yet incorporated into existing address standards, and at the same time ensure that existing standards were taken into account and, where possible, recommended for re-use in order to avoid duplication. In light of the review's conclusions, the ISO 19160 project issued a set of recommendations for the development of a suite of international address standards. The first recommendation was to develop ISO 19160–1, entitled *"Addressing – terminology and conceptual model."* This model would not seek to replace conceptual models in other addressing standards. Rather, it would endeavour to cross-map between those models, for example, by mapping the "ThoroughfareName" component in the INSPIRE data specification on addresses (INSPIRE, 2009) to its equivalent in the South African address standard, SANS 1883, namely, the "StreetName" (SABS, 2009). The ISO 19160–1 model should be extendable to the specific requirements of individual countries or communities and should be usable as a blueprint for address databases.

The second recommendation was to develop ISO 19160–2, entitled *"Addressing – good practices for address assignment"*. This document will provide guidance to countries that have to develop a new address assignment scheme, or want to evaluate or improve an existing scheme.

The third recommendation was to develop ISO 19160–3, *"Addressing – quality management for address data"*, which consists of measures to assess and communicate the quality of address data in terms of attribute (thematic) accuracy, logical consistency, completeness, positional accuracy and temporal accuracy, among others. Such a quality standard will support national address infrastructures by providing consistent guidelines to measure and report on the quality and integrity of data.

The fourth recommendation proposed that the existing UPU standard S42, *"International postal address components and templates"*, be adopted as ISO 19160–4, *"Addressing – international postal address components and templates"*, among the suite of international addressing standards. UPU S42 already covers the important requirement of interoperability by means of clear postal rendering rules. This is essential for streamlining global postal services.

Addresses from different parts of the world

The fifth recommendation was to analyze the ways in which addresses are rendered for purposes other than mail, such as web-based maps and graphic displays for handheld devices and mobile phones, and to ascertain whether a standard is required to assist developers of software with the display of addresses on digital output and in user interfaces.

In the future, national address infrastructures will be able to use software and other tools developed for ISO 19160–compliant addresses. It is therefore important that national standards conform to ISO 19160. The results of the review, the recommendations and an overview of the reviewed standards have been published in a report available online (ISO, 2011). The bibliography of this report contains address-related publications and references regarding address standards. These referencies will prove useful for developers of standards in a national address infrastructure.

At the time of writing, it was expected that the second phase of the project would commence in November 2011, with work on the first recommendation, ISO 19160–1, *"Addressing – terminology and conceptual model"*.

Standardization requirements in address infrastructure

Table 1 lists the standardization requirements identified by the ISO 19160 project. The subsequent sections discuss how standards in a national address infrastructure should ideally

Standardization requirement	Benefits
Address assignment scheme	– Consistent address assignment in the physical world – Understanding of addresses
Terminology	– Unambiguous communication about addresses – Understanding of addresses
Conceptual model (including metadata, life cycle and address aliases)	– Address databases based on the conceptual model – Understanding of addresses
Rendering of addresses on mail items	– (Automated) processing of mail items
Encoding(s) of the conceptual model (e.g. XML schema)	– Exchange of digital address data, either in bulk or one by one through, for example, web services
Address data maintenance	– Definitive address dataset
Address quality management	– Improved address quality

Table 1. Address standardization requirements and their benefits

be developed to meet these standardization requirements. The discussion shows how the standards are interrelated, implying a logical sequence for their development. This is not a reflection of current common practice in countries (e.g. many countries have standards for rendering specifications but no conceptual model standard), but rather a recommendation for the development of address standards to ensure a harmonized suite of standards in a national address infrastructure.

The address assignment scheme(s)

An address assignment scheme identifies the components that make up an address and describes how values are assigned to these components. A national address standard should identify and describe the address assignment schemes that are used in the country. It is not necessary to prescribe a single scheme, but it is important that each scheme and its area of jurisdiction be described. In the future, ISO 19160–2, *"Addressing – good practices for address assignement"*, will provide guidance on how to develop a national standard for address assignment schemes.

Addressing terminology

Terminology refers to the terms and definitions that describe addresses and the address assignment scheme. Terminology is important for communication about and understanding of addressing. Standards for the address assignment scheme and terminology are the absolute minimum requirements for a national address infrastructure.

The conceptual model

A conceptual model describes addresses, in other words, the meaning of the concepts involved and the relationships between them. The conceptual model reflects use of the address assignment scheme in the physical world. The ISO 19160 review showed that an address often consists of a combination of components or elements, organized according to a hierarchy. The conceptual model is the second most important standardization requirement in a national address infrastructure.

The national conceptual model should include metadata, life cycle and address aliases. Address-specific metadata provides information about the address, such as the custodian, lifespan and status. Metadata is used during exchange and maintenance of address data and is important for understanding the address. Life cycle tracks the temporal phases (e.g. future, active, retired) of an address. The address standards reviewed by the ISO 19160 project demonstrated consistency in the requirement to track the life cycle of an address record in the database and, more importantly, of the address in the physical world. Address aliases, such as multilingual addresses, abbreviations in the address or alternative addresses for the same addressable object, are used on a daily basis worldwide.

In the future, terminology and conceptual model standards in a national address infrastructure should conform to the requirements of ISO 19160–1. Where necessary, country or community-specific extensions can be made.

Specifications for rendering addresses on mail items

Standardizing address rendering, for example, specifications for the rendering of address labels on mail items, streamlines mail production and processing. A standard for address rendering also makes it easier to display addresses on maps and digital displays. The postal operator(s) in a country should take responsibility for this standard, which should follow the specifications laid out in UPU S42 (ISO 19160–4). The rendering specifications should be based on the national address assignment scheme and conceptual model, but might have to be extended with postal components, such as postcodes or other delivery elements (e.g. P.O. Box).

Encoding

An encoding standard specifies how addresses are represented in an electronic message or data file, thus facilitating electronic processing and exchange of addresses. Exchange of addresses takes place between users (citizens) and producers (local governments) of address data, or between different users (electronic business partners). The encoding standard should be based on the national address assignment scheme and conceptual model. It could also specify how addresses are to be represented in international encodings, such as that provided by the Organization for the Advancement of Structured Information Standards (OASIS, 2008).

Address data maintenance

A standard for address data maintenance is only relevant when address datasets are maintained. Such a standard allows address data producers to aggregate and update data according to a set of procedures and rules. A

definitive national address dataset is often the ultimate goal of a national address infrastructure. However, few of the address standards reviewed by the ISO 19160 project included specifications for the maintenance of address data, possibly because address data custodians are not identified or because addressing responsibilities are decentralized within the country.

Address quality management

All the standards discussed so far support the quality of addresses, for example, by ensuring the existence and accuracy of the components of an address. However, a standard for address quality management contains procedures and measures for the development, maintenance and communication of the quality of an address. A national standard for quality management will assist in improving the quality of address data in a national address infrastructure. In the future, such a standard should be based on ISO 19160–3, *Addressing – quality management for address data*. If required, additional quality management, specific to the relevant national address infrastructure, can be specified.

Design considerations for the development of a national standard

There are many issues to consider when developing a national standard for an address assignment scheme. A few of these are discussed here and further information can be found in Annex A.13 of the ISO 19160 report (ISO, 2011), which includes descriptions of a variety of address assignment schemes (axial, linear, area-based) with examples from Australia/New Zealand, Canada, Costa Rica, Japan, the Republic of Korea, Saudi Arabia, South Africa, the United Kingdom and the United States of America.

Addresses are used to identify many different objects, such as people, buildings, landmarks, places and even objects in transit. Some addresses include a third dimension relating to levels above or below ground (e.g. flats and offices in multi-storey buildings and underground utility connections). It is important to specify in the national standard for an address assignment scheme which objects are being addressed.

Addresses are used for a wide variety of purposes: postal delivery, emergency response, customer relationship management, land administration, and utility planning and maintenance, to name a few. Often these purposes have conflicting needs. For example, the geographical precision and accuracy required may vary: a large-scale geographic overview of addresses is required for utility planning and maintenance; accurate identification of individual address locations is crucial for mail delivery or emergency response; and only the place name in the address is of relevance in a customer analysis.

Given the variety of purposes, an object can have several addresses. For example, some locations might have one address for a front entrance (for receiving visitors) and another address for the back entrance (for connecting utilities). Moreover, a house can have a postal street address for mail delivery and a residential street address for directing someone to the house. To illustrate this, "Glenstantia" in the postal address below refers to the name of a post office, while "Constantia Park" in the residential address refers to the name of the suburb, which appears on signposts. Both addresses designate the same location:

- 42 Rover Street, Glenstantia, 0181, South Africa (postal address)
- 42 Rover Street, Constantia Park, Pretoria, South Africa (residential address)

Clearly then, different addresses are sometimes used to identify the same object but for distinct purposes. If at all possible, such ambiguities should be avoided in the national standard for an address assignment scheme. If this is not possible (e.g. for historical reasons both addresses might be in use), the standard should provide clear guidelines on how to deal with the ambiguities.

How precise does the address need to be? First of all, an address can be absolute or relative. In the latter case, the location is specified relative to something else. An example of this might be a landmark or an informal address:

- The White House, Washington DC 20001
- Red house opposite the butcher shop, Tsamaya Street, Mamelodi, South Africa

Humans can adapt to find an address once in the general area. In the case of a small village, for example, an address with only the village name and region would be sufficient:

- Mr Joe Mahlangu, Ratsegae, Rustenburg Municipality

In contrast, a utility company requires more information to identify and bill individual dwellings. Thus, the purpose of the address determines how precise it has to be. The intended precision of addresses should be specified in the national standard for an address assignment scheme.

An address typically consists of a number of components forming a hierarchy of names and/or numbers, each with an increasing level of precision. For example, a European city-style address usually comprises one or more place names, a street name and a number, while a Japanese address is made up of a prefecture name, a municipality name, one or more place names, and a parcel or house number (ISO, 2011). The components that make up an address, and the relationships between them, have to be clearly specified in the national standard for an address assignment scheme.

The rules according to which values are assigned to address components vary greatly. For example, address numbers can be assigned independently along a thoroughfare, with numbers proceeding according to a numbering rule from an origin point to the end of the thoroughfare. Alternatively, address numbering can be organized around axes that extend from a common point of origin (the local "zero" point for address numbers), with all numbers increasing with distance from the point of origin. There are many more examples of address numbering, such as the use of geographic coordinates (Saudi Arabia) or distance from an intersection (Australia/New Zealand) (ISO, 2011). It is important that the rules for assigning values to address components be included in the national standard for an address assignment scheme.

It is also important to ensure that the addresses based on the address assignment scheme can be used for postal operations, utilities, censuses, land administration (cadastre) and financial systems, among other things.

In most cases, there is no single authority responsible for assigning values to the individual components of an address. For example, in

South Africa, the Municipal Demarcation Board assigns municipality names, while municipalities themselves assign street names. For place names, a naming process has to be followed, and the South African Geographic Names Council administers this process. Moreover, the South African Post Office assigns postcodes to addresses. The organizations responsible for assigning values to the individual address components have to be clearly identified in a national address infrastructure.

While a single address assignment scheme per country is more efficient, there are several reasons, such as local cultural relevance or cost implications, for a country to support more than one scheme. The short-term costs of implementing a single, efficient address assignment scheme have to be carefully weighed against the long-term financial benefits of such a scheme. The design of an address assignment scheme involves a trade-off between people, the physical world and the digital representation of the physical world (Coetzee, et al., 2011).

People refers to all the "human" requirements of a national address infrastructure. People should be able to read, understand and remember addresses (e.g. one should intuitively know what the next address down the road is). Moreover, addresses should reflect the local culture, be in harmony with political objectives, and support the social and civic identity of the people living there.

The physical world refers to the actual location of the address and how it is used. This world includes signposts for the address on the object itself, but also signposts for other address components such as the street and place name. It includes the elevation level of an address (i.e. which floor) and the entrance(s) to the object in relation to where the address is allocated or signposted. Furthermore, multiple addresses for a single object and multiple objects may share an address.

Finally, digital representation refers to the way in which addresses in the physical world are represented digitally. Important design considerations involve the efficiency of representation for storage and processing on a computer, including the systematic assignment of addresses, the algorithmic processing of addresses, character recognition of addresses (e.g. for mail sorting), and integration with other systems.

To illustrate the trade-off that must occur, consider the costs involved when people change street names to reflect a change in the political system: both the physical world and its digital representation (e.g. in a database) have to change accordingly. The potential cost of replacing signposts is huge. Likewise, the cost of the ripple effect in the electronic processing of addresses is significant: people will continue to use the old address for quite some time and electronic systems have to be backwards compatible.

Conclusion

A national address infrastructure should at the very least include standards for an address assignment scheme and terminology. A conceptual model is the next most important standardization requirement. Furthermore, specifications for the rendering of addresses on mail items are required for efficient mail processing, and an encoding standard is needed for the electronic processing and exchange of addresses. In terms of address data maintenance, a standard is relevant only when address datasets are maintained. In such cases, a quality management standard (procedures and measures for the development, maintenance and communication of the quality of an address) will also apply.

In the light of the trade-off and design considerations discussed in this chapter, a national standard for an address assignment scheme should define the following:

- The **objects** that are addressed;
- The **purpose(s)** for which the addresses are assigned;
- The **intended precision** of the addresses;
- The **components** making up the addresses; and
- The way in which **values** are assigned to these components.

In addition, a national address infrastructure must identify the organization that has a mandate for the assignment and maintenance of:

- Addresses by **people** (e.g. naming);
- Addresses in the **physical world** (e.g. signposts); and
- The **digital representation** of addresses in the physical world (e.g. data model, databases, etc.).

In the future, national address infrastructures with standards that conform to ISO 19160 will be able to leverage the benefits of international standards, including the ability to use ISO 19160–compliant software and tools.

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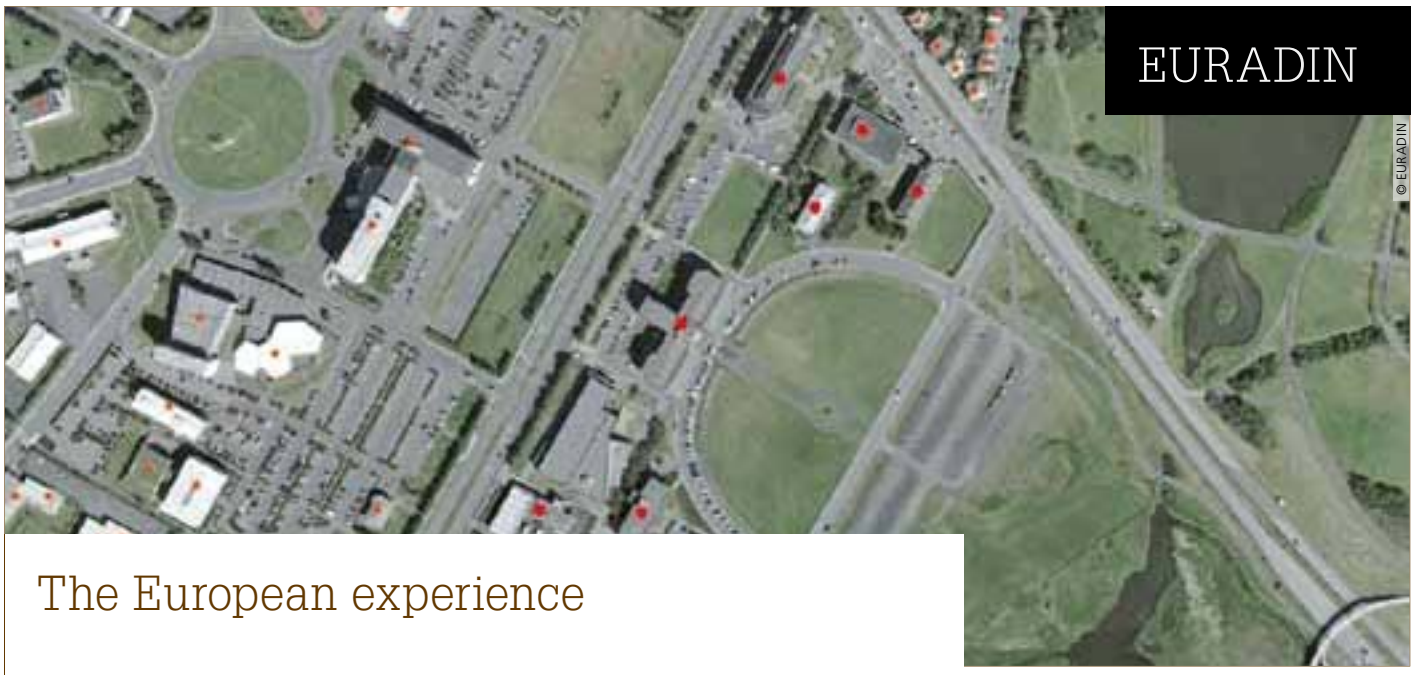

The European experience

Háskóli Íslands, Iceland

Addresses are a common language providing citizens, business entities and public administrations with a simple and clear description of location. The majority of economic activity, for example, relies upon addresses for the delivery of goods and services. Proper addressing, therefore, can greatly enhance efficiency, and has a considerable impact on the value or cost of services. Addresses also function as a common reference linking people or applying information from different sources, particularly, in today's interconnected, high-tech world.

Well-structured, high-quality address data has come to be widely recognized as an important part of society's infrastructure. Organizations such as the World Bank, the International Organization for Standardization (ISO) and, in particular, the Universal Postal Union (UPU) have declared addresses to be an essential tool for economic and social development, and have underlined the vital need to establish a complete, correct and unique addressing system in many countries, both developing and industrialized. In Europe, during the preparation of the Infrastructure for Spatial Information in Europe (INSPIRE) directive, addresses were recognized as one of the top priority data themes and as a necessary common reference in the development of a European spatial data infrastructure.

The European experience in the field of addresses can be summarized in two initiatives: the European Address Infrastructure (EURADIN) and the European Address Forum (EAF). These initiatives share the common aim of providing interoperable address systems in Europe. The work undertaken by EURADIN (ECP-2007-GEO-317002) and co-funded by the European Union (EU) under the eContentplus programme had two purposes: first, to form a best practice network to promote European address harmonization regarding the definition, registration and accessibility of European address data; and, second, to demonstrate the substantial benefits to society of proper addressing, in terms of economic and practical value. The EAF was created as an extension of EURADIN to encourage awareness of the benefits of addressing, including efficient emergency response and new value-added products and applications.

Background

The Geographic Information Network in Europe (GINIE) project, which took place between March 2001 and 2003, reflected agreement among a number of address experts from different EU member countries to cooperate in the field of addressing. In May 2005, the Address Infrastructure Workshop at the GIS PLANET conference in Estoril, Portugal,

EURADIN
European Address Infrastructure

European Address Forum

Navarra region, Spain

Pamplona county, Navarra, Spain

Pamplona city, Navarra, Spain

recommended the creation of a lightweight electronic network of address experts, sponsored by the European Umbrella Organisation for Geographic Information (EUROGI). This idea received further support at the annual Nordic Address Meeting held in Stockholm in June 2005.

In November 2005, based on these recommendations, several experts from Denmark, Portugal and the United Kingdom drafted an invitation for participation in a European address forum. This idea was presented and further developed at different events. During the closure of the Cross-border Spatial Information System with High Added Value (CROSS SIS) project, held in Pamplona, Spain, in June 2007, the German region of North Rhine-Westphalia proposed that collaboration continue under a new project related to addresses. As a result, the project and its partnership were configured in October, culminating in the launch of the EURADIN project in 2008.

The objective of EURADIN was to advance practical implementation of the address-related themes of the INSPIRE directive in as many European countries as possible, including establishment of a best practice network.

With the support of EU funding, 30 private and public sector organizations from 16 countries partnered with EURADIN. They progressed rapidly in their research and prepared reports on implementation, standards, workflow, metadata requirements, business models and recommendations for addressing best practices. EURADIN members also expressed willingness to create a European forum on addresses to extend and broaden the work of the project in subsequent years. In June 2009, during the EURADIN Second General Assembly, held in Madrid, agreement was reached on the creation of a core group comprising several addressing expert partners. They would develop a proposal on a sustainable structure for the EAF so as to guarantee continuity of EURADIN cooperation beyond the end of the project.

EURADIN

One of the objectives of INSPIRE is to lay down general rules for the establishment of spatial information infrastructure in Europe. EURADIN contributed to this address component of the directive (Theme 5, Annex I). EURADIN sought to create a best practice network to promote European address harmonization with regard to the definition, registration and accessibility of European address data. The main target result was a proposal for European address infrastructure and the implementation, testing and validation of its pilot. However, EURADIN went further, proposing a concrete design and validating the European address infrastructure pilot, as well as delivering recommendations and guidelines for European countries to establish their own national address infrastructure.

Coordination between INSPIRE and EURADIN was essential for the project's success. EURADIN maintained continuous contact with the INSPIRE community in order to apply the directive's recommendations and implement its rules and specifications in all work carried out under the project. This cooperation was reinforced through the participation of several EURADIN partners in the INSPIRE Thematic Working Group. These partners collaborated in the preparation of address data specifications, which were further tested and validated by other address data providers participating in the project.

The EURADIN project began on 1 June 2008 and lasted 24 months with a budget of 4 million EUR. Partners included main European stakeholders and experts in the field of addressing. The core of the project consortium was composed of several public organizations (regional governments, national mapping agencies, national cadastral offices) from European countries that had already worked in addressing at a regional or national level to harmonize addresses and addressing systems. The partnership also included private companies, representing data producers and

Pamplona city center, Navarra, Spain

Plaza del Castillo, Pamplona, Navarra, Spain

Plaza del Castillo, Pamplona, Navarra, Spain

address users. The project comprised nine work packages: management, initial assessment, data model, metadata, data flow, business model, validation, overall assessment and networking and dissemination.

Management

Coordination of the consortium was key to ensuring completion of all planned project activities according to established deadlines. The established management structure helped to minimize problems and anticipate risks.

Initial assessment and user requirements

The European member states and organizations involved in the project each had different political, economic, cultural and organizational drivers, and thus different positions regarding addresses. The first step towards harmonization of addresses was to analyse existing address systems in Europe, from a European, national and regional point of view. The countries participating in the project were taken as a reference, and the project was then extended to other EU countries. The project also evaluated, selected and documented examples of best practices. These served as the basis for the address harmonization proposal at European level. The resultant methodology involved specific questionnaires designed to guide the data collection process with relative speed and flexibility. The objective was to obtain a repository of necessary information to build a first-class European addressing system.

The project included Europe's most relevant addressing players; they described the project's major challenges as follows:

- European address systems were heterogeneous on account of different national regulations, responsible offices and development statuses. Better coordination among all stakeholders was required in order to create a European address infrastructure, prevent delays in the updating process for new buildings/addresses, and facilitate information sharing.
- Thirty percent of partners did not have an addressing system and less than one half were backed by a legal norm.
- Less than 50% of analysed addressing systems included metadata information. However, most addressing systems that incorporated metadata used the ISO 19115 standard.
- Half of the organizations used the Internet to distribute address information, while the rest continued to use CD/DVD distribution.

The diagnostic showed that the selected methodology was effective for addressing system surveys. The methodology also allowed for more efficient processing and comparison of received data, and could be used to filter future best practices for inclusion in the addressing best practices network. The final conclusion was that interoperability of address systems should be improved to prepare for the technological framework of coming years.

Data model

On the basis of the conclusions obtained from the diagnostic study and the available INSPIRE specifications and implementation rules, the team working with the address data model embarked on the task of matching the existing INSPIRE framework to the topic of address data. The purpose of this task was to deliver a technical proposal on harmonized data specifications for the address theme. The result was a proposal for address data specification, standardization and harmonization, developed with the consensus of the consortium and covering the essential European critical mass.

The team assessed existing concepts and attributes – post codes, geographic coordinates of the address reference point, town, street, house number (and annex), textual descriptions and country specification – and selected the necessary attributes for data

specification purposes. This led to the creation of the harmonized approach necessary for an interface between the national level and the INSPIRE framework. The INSPIRE framework was also the reference point for data (address) specification and the harmonization proposal. Specifications produced by the INSPIRE Data Specifications Drafting Team formed the initial basis for the work carried out: they were used to define the rules on conceptual modelling[1)] in addition to the methodology[2)]. The last technical document from the INSPIRE Data Specifications Drafting Team on GML encoding[3)] became the reference for the data exchange model, a key tool for interoperability.

One of the challenges EURADIN faced was synchronizing its activities with the INSPIRE roadmap in order to draw on the strengths of both teams to reach a common objective. To this end, the teams worked together to prepare addressing data specifications that would cover needs in all areas and could be validated by the EURADIN partners with a view to creating the European address infrastructure. This cooperation led to a final model of addresses that largely fulfilled the requirements for harmonizing addressing at the European level: INSPIRE address data specification versions 2 and 3.

Metadata

Metadata plays an important role in addressing by providing "data about data contents". For example, metadata contains information on how, when and why the data was created, as well as information on the owner and party responsible for the data. All of this information forms a metadata profile, created according to a standard designed to enhance quality.

The main objective of EURADIN in this work package was to provide a new metadata profile for the address theme. This profile was to be based on existing profiles used in the European regions and countries involved in EURADIN, with the new metadata conceived within the framework defined by the standards and reference documents. Development of the metadata profile, together with its guidelines, was followed by an evaluation of its applicability to real data by means of a software tool designed specifically for metadata creation and editing, according to the EURADIN Metadata Profile (EMP). The applicability of the metadata profile was verified, and once accepted, the tools for gathering address metadata according to the new profile were implemented, along with other basic tools for address database transformation, and offered as a free and open-source product.

Further conclusions were obtained regarding the state-of-the-art metadata on the basis of the diagnostic carried out in work package 1:

- More than half of partners' addressing systems, which included metadata or whose profiles were under construction, worked with metadata according to the ISO 19115 standard, as requested by INSPIRE. However, there was no focus on metadata specific to addresses.
- There were no reports of best practices on address metadata that could be used to support the development of the EURADIN Metadata Profile. The metadata profile was developed from metadata information relating to all addressing systems involved, as a result of contributions from almost all EURADIN partners in this work package.

Euradin participation partners

Data flow

Address-registration procedures differ widely among European countries and regions; therefore, the goal was not to harmonize existing procedures, but to define a prototype workflow (from local to national) in order to realize a national interface (node). This goal was meant to fulfil the INSPIRE directive of developing recommendations and guidelines to help European member states adapt to the defined prototype workflow (Data Flow Cookbook). A generalized data flow must support a logical or easy process and lead to a high-quality, accurate and complete dataset. However, because of the differences between member states, a best practice framework was created instead of a single best practice data flow.

It was not possible to define a single harmonized European workflow for addresses; however, the initial step of the flow (registration and georeference) corresponded to local authorities, and implementation and dissemination could be done at any level of administration. It was concluded that the situation in each member state would influence the organizational structure and would therefore define its data flow. This organizational framework would form the basis for technical implementation in each state. However, it was noted that organizational problems had to be solved prior to technical implementation, and that any data flow had to be based on web services and implemented in the existing spatial data infrastructure.

Business model

This work package determined the potential social and economic benefits of delivering point addresses to the European market and examined in particular the relevant market segments and applications. This involved analysis of the potential benefit of delivering geocoded addresses to the European market in the light of related social and economic benefits – one of the primary strategic issues of the business model.

Within the EU, several variations of two potential business models exist for the creation and management of address databases. The two models sit at either end of the spectrum and both have their own challenges:

- The first model assumes that data is collected at the cost of the public sector and are either distributed

for free or at the marginal cost of distribution (which is frequently also free) with very light licensing terms. The economic justification for this model is the substantial value that the process, when efficiently and comprehensively managed, can bring to the wider economy and the public sector. In this model, different parts of the public sector (national, regional or local) may play distinct but complementary roles.
- The second model assumes that the data, whether collected by the public or private sector (or a publicly owned body such as a postal service), are charged for, either at a profit or on some form of cost-recovery basis with a protective licence covering intellectual property rights.

The results showed that a comprehensive, harmonized and geocoded address database available across the EU could result in potential payback of billions of euros worth of improved efficiency every year, fewer unnecessary duplicated efforts, faster response times, saved lives, broader tax collection, and intangible socio-economic benefits improving the welfare of the state. The exact amount was difficult to evaluate, but it was tentatively concluded that the overall value could be as high as 0.5% per annum of the EU's GDP, for a total of about 63 billion EUR.

Validation: European gazetteer

Gazetteers associate locations with a geographic identifier. Their role is to reference the spatial object representing the location. Gazetteer services provide a quick method of locating and retrieving spatial objects by name; for example, they can be used to identify addresses or settlements that lie within an administrative area or a postcode. Although gazetteer services are not explicitly mentioned in the INSPIRE directive, the work on drafting implementing rules for data specifications identified a gazetteer service, or services, as a key functionality required by final users for many purposes. In addition, since addresses constitute a theme of INSPIRE Annex I, the gazetteer service should be accessible through the general set of services, as defined in Article 11 of the directive (e.g. view and download services).

The development of a European Address Gazetteer served to validate the proposal for address harmonization and specification. The gazetteer gave access to the addresses of several European countries and/or regions participating in the project. This access was provided through network services that allowed the address spatial data to be combined with other harmonized data in a coherent way. Two main decisions were taken:

- To have a full gazetteer service in conformance with the specifications for the INSPIRE direct access download or web feature service;
- To have a web service with functionality according to defined use cases, including geocoding and reverse geocoding.

The central service was based on a distribution resolver concept, where incoming requests would be distributed to the different underlying local services, and the response aggregated and returned.

Seventeen partners, on different hardware and software platforms, were involved in implementation of the services. Two types of local services were implemented along with the central distributer service. The European Address Gazetteer also demonstrated that current mainstream technology platforms limit the potential for interoperability.

Overall assessment and conclusions

Partners participating in the development of the European Address Gazetteer were asked to give feedback on activities carried out during the first year (related to data, metadata, data flow and the business model), which had provided the harmonized solution for the gazetteer. This feedback was then incorporated into the review and assessment process, which analysed results from the project's first year and proposed improvements. Formulation of the overall project conclusions and analysis of research gaps and remaining potential then became the basis for the drafting of the strategic research agenda for European address harmonization.

The project involved a number of practical activities to provide pan-European access to addresses following a specified standard. In terms of added value and lessons learned, EURADIN accomplished the following:

- Increased knowledge of existing address culture at the European level;
- Sharing of this knowledge now and in the future;
- Creation of a harmonized specification based on existing information and best practices at a European level, which all European countries can continue to build;
- Development of a network of highly knowledgeable experts (involved in the project partnership) and other people and institutions outside the consortium;
- Proven viability of a central address multi-database hub for Europe, serving as a very interesting test bed for the INSPIRE initiative;
- Feasibility of application of the INSPIRE-based data model was demonstrated, and one of the core INSPIRE datasets was delivered, and thus the benefits intended by the directive.

Networking and dissemination

The dissemination activities were targeted to different audiences and focused on the project's beginning and its results as they became available. Networking activities concluded with the preparation of the *"Addressing the Future"*, the first European Address Conference, held in Brussels in 2010. At this conference, the European Address Forum was formally launched and the final results of EURADIN were presented.

EURADIN also identified a set of solid research priorities and drafted a strategic research agenda for the harmonization of addresses in Europe, including several recommendations on harmonization (data, metadata, data flow), gazetteer services, quality aspects, standards and the reuse of public sector information. The strategic research agenda provides an opportunity to collaborate with other European organizations in order to present new proposals to the European Commission.

European Address Forum (EAF)

One outcome of EURADIN was agreement among its partners on the need to create a European Address Forum to extend and

reinforce the work begun by EURADIN in coming years. In June 2009, the EURADIN Second General Assembly approved the establishment of a core group as a sustainable long-term structure for the project.

The EAF was formally created in Brussels in June 2010. Its aim is to encourage the development of well-structured addresses and addressing processes, and the availability and efficient use of harmonized and good-quality address data throughout Europe, for the benefit of citizens, business and government. This is to be achieved through the use of INSPIRE's framework and related standards.

The EAF has the following objectives:

- Support and monitor the fulfilment of the INSPIRE directive in the area of addressing and directly related themes;
- Build on the work done through EURADIN and collaborate with other relevant initiatives;
- Act as a forum to share knowledge and exchange views, contributing to the identification of best practices in addressing and spreading knowledge of those practices;
- Serve as a meeting point between address data producers and users;
- Consider appropriate referencing methodologies and related issues;
- Propose address quality assessment methodologies;
- Identify and promote the adoption of core standards, specifications, technical developments and concepts to make address data more accessible;
- Combine consensus building/awareness raising with large-scale, real-world implementation by its members wherever possible;
- Offer a knowledge base to regional initiatives seeking to consolidate at the national level and helping to improve quality generally from local to national level;
- Generally support the European information society and knowledge economy.

The EAF is above all a lightweight e-network that encourages the involvement of all stakeholders working in addressing processes in the collection, maintenance, use and dissemination of address data. EAF is therefore open to all European citizens and organizations that are responsible for or have a professional interest in addressing and address data, whether from the public, private, voluntary, research or academic sector, or from society at large.

The EAF provides a forum to:

- Exchange and share experiences;
- Help members stay up to date with relevant initiatives;
- Provide assistance for members wanting national support;
- Build international awareness;
- Manage an annual conference for specialists;
- Disseminate best practices;
- Secure the attention of key decision-makers;
- Reinforce the adoption of relevant standards throughout the EU; and
- Support the aims of INSPIRE.

The EAF also aims to support the existence of address forums in various geographical areas, such as the Nordic Address Forum, the Spanish Address Forum and the proposed Ibero-American Address Forum. For example, the Nordic Address Forum was a decisive reference in the creation of the EAF. The Spanish Address Forum, created in 2009, contributed to a qualitative change in address management in Spain in 2010. The most relevant milestone of that forum was the presentation of a single model of postal addresses to be shared by all government agencies in Spain.

The EAF also carries out additional activities, such as address workshops, to encourage the creation of addressing systems in other countries. It has also promoted cooperation, for example, to guarantee funding for Ibero-American addressing systems.

Conclusion

EURADIN and the EAF have provided valuable guidance for the creation of an EU-wide addressing project. They have undertaken a complete diagnostic of the status of addressing systems in all EU countries within the framework of the INSPIRE directive. It is important to note that the feasibility of a gazetteer at European level has been demonstrated, and the challenge is now to turn it into an operational service. INSPIRE encourages the implementation of a common address data model; however, European countries still have work to do in this respect – in some cases to even create an addressing system. In this context, shared experiences become critical. Perhaps most decisively, it is essential to have the resources to support coordination, collaboration and collective learning, to ensure the viability and sustainability of efforts to harmonize addressing.

This European experience has underscored the fundamental role of addresses in our society and their impact across all sectors. A more serious, consensus-based approach on the issue of addressing is now necessary to ensure the standardized development of addresses of quality, through the use of a single, common model, applicable worldwide. The experience gained through EURADIN and the EAF can and should be extrapolated to other regions, such as Latin America, where work is already underway to set up the Ibero-American Address forum, with the support of the EAF.

Further details related to both projects, including the lessons learned and best practices, are available through the EAF website.[4)]

1) D2.5, Generic conceptual model.
2) D2.6, Methodology for the development of data specifications.
3) D2.7, Guidelines for the encoding of spatial data.
4) The EAF website is available at: www.eaforum.eu

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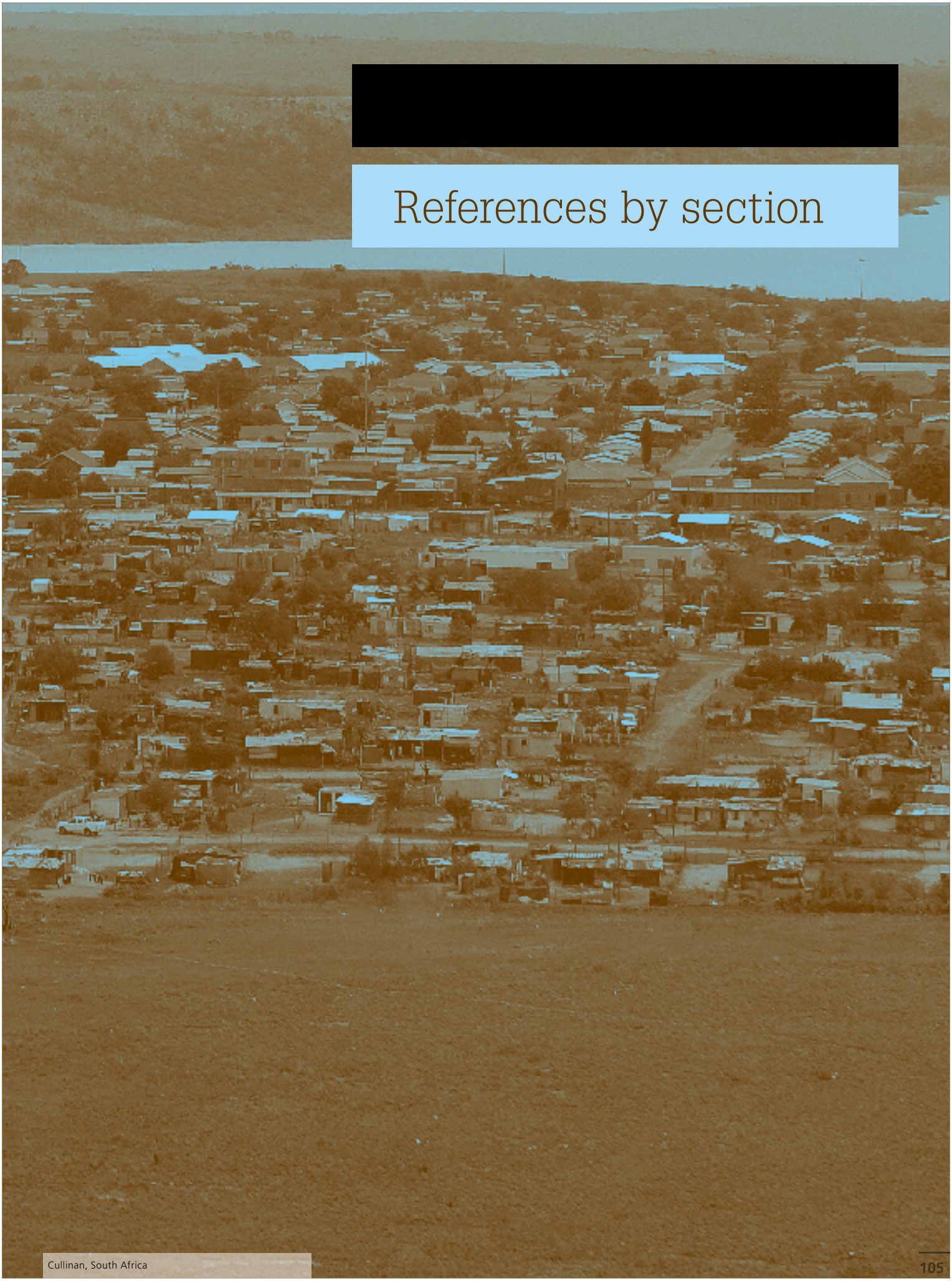

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