

# Rethinking Infrastructure within Denmark's Real Property Data Reform

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**Key words:** e-Governance; Real property data infrastructure; Interoperable key-registers; Event driven architecture; Business process modelling; Program management

## SUMMARY

Denmark is reforming the registration of real property data, which makes up a business case for significant efficiency improvements of the work flows between registers. This pertains both to redesigning core business processes with a view to reduce the risk of human error and to facilitate the handover to new employees who are not necessarily experts in real property and legacy IT systems.

In 2012, the Danish Government launched the Real Property Data Program (RPDP) with dual objectives. First, RPDP intends to improve efficiency of real property data registration and administration at central and local government levels. Second, RPDP establishes a common data infrastructure that stimulates the re-use of real property data in the public and private sectors. Currently, RPDP is in the development stages and is expected fully implemented and ready for operation by mid-2017. The program is backed by an open data initiative that makes most public data, including real property and map data, freely available to users.

The RPDP responsible parties are the register authorities (Land Cadastre; Building Cadastre; Real Property Ownership and Land Registry) and the major public beneficiaries (real property valuation and taxation authorities). A detailed business case documents the potential efficiency gain for the RPDP to gather.

Today, Denmark's real property data is registered at independent public authorities using different keys for identifying real property objects, which can make it difficult to compare and combine data across registers. Thus, resources are used on quality checking data and double data entry at users' databases. RPDP deals with these data inconsistencies in two ways. The data models of the various registers have been harmonized, and a new common agreed real property identifier replaces the old register-specific identifiers. A comprehensive data cleansing has been performed to improve the data quality of property registers: errors are corrected, irrelevant information is removed, and missing data is supplied.

The Danish RPDP approach is significant because of its both holistic and business-oriented view on IT-infrastructure developments. The approach is holistic because several IT-infrastructure aspects at four different registers have to be considered simultaneously. These diverse focuses are essential because even the most efficient work procedure fails to function without sufficient IT support or high quality data. RPDP is business-oriented because each work procedure has been leaned to meet specific business requirements; it will simplify administration, reduce errors, and eliminate the obstacle to public and private-sector use of the data.

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## 1. INTRODUCTION

### 1.1 Background

In 2002, the Danish Government approved that both central and local government real property data registrations should be made available to public and private users – free of charge. This initiative included data from the following registers and systems: Land Cadastre, Building Cadastre (buildings and dwellings), Municipal Property Register (ESR) and State Register of Real Property Valuation. Consequently, a public data warehouse system (OIS) was established for dissemination of data from these registers. At OIS (<http://ois.dk>), property data are made available and accessible to everybody. This early open data initiative has ignited innovation among private entrepreneurs. They took advantage of the free data and developed IT-system solutions and services for use and benefit to both public and private industries. In 2014, also the Land Registry was opened allowing users to acquire land register data free of charge via the Registry's web services.

### 1.2 The Danish property data infrastructure

The Danish real property data infrastructure is de facto constituted of the below real property registers together with the OIS-datawarehouse. The registers have been established to meet specific needs. The registers refer to four different legislations and are administered by ministries and agencies.

#### 1.2.1 Land Cadastre

The Land Cadastre was originally established for fiscal purposes. Today, it is the base register for identification of land parcels and some specific restrictions of use. A real property object in sense of the Land Cadastre is one or more jointly registered land parcels. Cadastral properties are identified by a unique ID (SFE-no) with a secondary combined key: cadastral number + cadastral sector number. Note that : the real property types “condominium” and “building on leased land” are not known to the Land Cadastre.

#### 1.2.2 Land Registry

The Land Registry registers transactions on real properties and agreed property rights, including change of ownership, mortgages and restrictions of rights (servitudes). The Land Registry receives cadastral updates (e.g. subdivisions and amalgamations) from the Land Cadastre. The Land Registry is the base register for registration of condominiums. The Land Register will register buildings on leased land, but only if the building is subject to transaction and security of loans. The

Land Registry identifies real properties via a complex combined key of cadastral number, cadastral district, condominium number and building number. Note that it is not compulsory to register property rights, including transfer of property ownership, thus the register might hold information of owners that is out-of-date.

#### 1.2.3 Municipal Property Register

The Municipal Property Register (ESR) was the first Danish digital real property register. ESR comprises three legs: 1) Property data; 2) Property valuation functions; 3) Land taxation functions. This register holds a complete copy of the Land Cadastre registrations together with copies of Land Registry's condominium data. Buildings on leased land are registered in ESR independent of the registrations that take place at the Land Registry.

Since the Land Registry cannot guarantee to provide up-to-date ownership information, the ESR includes a property ownership register. Ownerships are maintained partly manually and partly automatically via electronic Land Registry notifications with information on registered ownership transfers.

ESR-properties are identified with a 10-digits unique property number.

#### 1.2.4 Building Cadastre (Building and Dwelling Register)

The Building Cadastre was initially established for valuation and statistical purposes. This register holds detailed information of both exteriors and interiors of all buildings and other constructions. This register is maintained on basis of data provided by the citizens who apply the municipal administration for permission to build. The buildings and dwellings of the Building Cadastre are linked to the real property objects of the Municipal Property Register via ESR-IDs (property number).

#### 1.2.5 Remarks of the current real property data infrastructure.

The above descriptions reveal that the current registration and use of real property information reflects the need of registers rather than of the data users. Each register authority originally developed IT-systems and workflows suitable for the register itself. These IT-systems were established before it was feasible to exchange and to combine data from various sources. The below table summarizes the Danish real property registers characteristics on central interoperability parameters.

**Table 1: Characteristics of Danish real property registers**

<b>Register</b>	<b>Real property term</b>	<b>Property ID</b>	<b>Property types in the register</b>
Land Cadastre	Cadastre property	SFE-no (unique)	Land parcel(s)
Land Registry	Land Registry property	Unique combinations of cadastral number, cadastral sector number, condominium number and building number	Land parcel(s) Condominium Building on leased land Others
Municipal Property Register	Valuation property	Property-number (unique)	Land parcel(s) Condominium Building on leased land Others
Building Cadastre	Valuation property	Property-number (unique)	Land parcel(s) Condominium Building on leased land

Today, the Danish real property data infrastructure is unnecessarily complex. To establish the complete picture of a real property object involves data gathering across registers. The registers use different keys for identifying real property objects and define common terms differently. This complex set-up with more data in different registers might leave the reader with an impression the Danish property data infrastructure is inadequate for the support of efficient and secure basic registration of real properties. On the contrary, the infrastructure works perfectly within the professional domain of each register. Examples: 1) The Land Cadastre ensures, in collaboration with licensed surveyors, a proficient and secure registration of land; 2) The Land Registry has a 100 per cent digital work flow based on digitally signed documents, and the state guarantees each registration and compensates if the registration is substantially incorrect.

The existing property data infrastructure is challenged on its interoperability. As illustrated in

**Table 1: Characteristics of Danish real property registers**

above, it could be a challenge to combine property data across registers, mainly because the registers define and identify some real property object differently. It works but manual interference

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is sometimes needed, which naturally opens for the risk of human generated errors. Furthermore, for building on leased land it could be a challenge to know which register is the most appropriate to use. Professional users expect that data from public registers are updated and trustworthy.

The Municipal Property Register (ESR) mainly holds data copied from authentic registers, but reorganized into the ESR data structure. The “non-authentic” ESR is a corner stone of the data infrastructure because it is the most complete property register, and therefore the register with most users. Many public IT-systems get property data updates directly from ESR, whereas private data users are supplied with ESR-data via the OIS-datawarehouse.

## **2. THE NEED OF RETHINKING THE DANISH REAL PROPERTY DATA INFRASTRUCTURE**

Since the first open data initiative of 2002, the demand of structured digital information on real properties has risen significantly in general and in the private sector in particular. Also the usage of real property information has changed over the years. Today property data is not only of interest to the conventional users, e.g. the financial sector and the construction industry, but property information has also become an integral data component of various other industries, for instance business consulting and communications.

Usually, data users outside the core of real property data domain are not capable safely to compare and combine data across registers. Therefore, the interoperability of the property data infrastructure is much more critical nowadays than it was earlier, when users in many cases had a professional background and knew the pitfalls in dealing with real property data.

Private data users (e.g. the financial sector, state agents, lawyers, and other real property market stakeholders) claim that the property data infrastructure does not meet the market needs of information and functionality. Concerning the users’ functional needs, it is not feasible under the existing data infrastructure to provide users with a closer business-to-business integration to the property registers. In 2013 - to meet users’ requirements - the Danish Government opened an online one-stop-shopping service for provision of standardized property data reports for potential real property buyers. This service provides yearly some 130,000 standard reports.

The first version of the Municipal Property Register (ESR) was established in the mid-1960s. ESR is a legacy system that technology wise is up-to-date; however, the overall system architecture, data structures and functionality are outdated. For this and other reasons, both the Local Governments of Denmark (representing 98 municipalities) and the Ministry of Taxation have launched initiatives to abandon ESR and move property valuation and property taxation businesses to modern and less costly IT-platforms. This has opened a window of opportunity to rethink the real property data infrastructure in a broader interoperability perspective.

### **2.1 Barriers for interoperability improvements**

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Among professional data users, it is recognized that the current Danish property data infrastructure does not support nowadays demand. The data users require harmonized property information that is made available and accessible via interoperable networks. The public and private sectors share the interest of removing any barrier that prevents the data users from efficient re-use of public property information.

The interoperability barriers are numerous. In this context, only the most significant barriers are considered. The barriers are conveniently grouped into technical and organizational/financial issues.

#### Technical issues that hinder interoperability improvements:

- Lack of common agreed property identification: *It is necessary to have a commonly agreed identifier to ensure a unique identification of real property objects across registers.*
- Lack of common agreed real property terminology: *To reduce risks of confusing the communication of property information, it is necessary that both data providers and users apply the same terminology.*
- Real property information is redundantly registered in more registers: *Double data registrations violate fundamental data management rules and should be abandoned. First, the slave might come out of synchronization with its master register. Second, double data entry and maintenance costs extra resources.*
- The property registers are lacking functionality that allows users' IT-systems to integrate further with the registers: *For security reasons, the users will not get direct access to neither the registers nor their associated production systems. Alternatively, a complete redesign of the data infrastructure based on the principles of service and event-driven architecture would allow users to be real time notified on data changes.*

#### Organizational and financial issues that hinder interoperability improvements:

- Each register authority is accountable that the register is adequate and administered in accordance with underlying law and regulations: *The register authority is delegated to perform specific tasks – no more, no less. Consequently, the encouragement for the register authority to consider cross-organizational issues is limited.*
- The running costs of the registers are financed under individual government budgets which diminish possible across registers developments: *Dedicated and limited budgets prevent registers from initiating significant data infrastructure developments.*
- Data users will have extra expenses for adoption and implementation of data infrastructure in their IT-systems: *If the implementation cost exceeds the benefits, the users will withdraw from investing in the required IT-system update. This issue is in particular relevant in relation to legacy systems (e.g. the Municipal Property Register), where required system updates are implemented at high costs.*
- Lack of financial encouragement for individual data infrastructure initiatives: *Usually, the benefit of data infrastructures initiatives are shared between the users of the infrastructure. Thus, it might be hard for individuals to establish a positive business case on isolated infrastructure investments.*

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## 2.2 Danish eGovernment Strategy 2011 – 2015

In 2011, the Danish Government in collaboration with Local Governments of Denmark (municipalities) submitted a common eGovernment Strategy for 2011 – 2015.

One of the strategy focus areas were “Shared basic data for all authorities”. This focus area included five initiatives, including an initiative on real property data: “*Reusing data on real property building and addresses*”. Further on this initiative the strategy states: “*In 2012, we will finalize our action plan for a stronger, simpler digital data infrastructure for the real property and buildings domain.*” .... “*Duplication of registers will no longer be needed, and local authority property registers can be rationalized*”.

For the first time, a Danish central Government strategy has addressed the real property data domain.

The other strategic initiatives with relevance for the property data initiative are:

- Distribution of base data: *Investigate the possibilities for a shared infrastructure for distribution of basic data.*
- More detailed geographic data: *Establish a single high-quality and easy-to-access authoritative source of administrative boundary data.*

### 2.2.1 Establishing a positive business case

The next step towards the realization of the vision of coherent real property data infrastructure was to establish an **action plan** for the eGovernment initiative. The initiative has been subject to detailed investigations to document that the vision is implementable and the plan has a positive business case.

The investigations were organized in a project group subordinated a steering committee with participation of the involved parties: Danish Enterprise and Construction Authority (chair); Min. of Finance; Danish Geodata Agency; Danish Land Registration Court; Min. of Taxation and Local Government Denmark (municipalities).

The investigations included the following activities:

- Development of a high level proposal of the ideas for a new property data infrastructure.
- Development of a technical proposal with descriptions of the various activities to be performed by the involved parties. This comprises: redesign of the parties external and internal business processes, IT-system specification and developments.
- Perform a comprehensive feasibility study of the proposed solution for qualifying and quantifying the impact of the initiative.

The business case was developed on basis of the above investigations. The business case comprises estimated benefits and cost estimates on the technical proposal.

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In parallel with the eGovernment initiative, the Local Government of Denmark (municipalities) announced a renewal of the Municipal Land Taxation System that strongly depends on the Municipal Property Register. Consequently, the municipalities need to substitute or renew the Municipal Property Register. The timing was perfect, since this major system renewal opens for inclusion of the Municipal Property Register into the overall business case.

The municipalities are primary beneficiaries of the initiative, mainly because they will save costs for development and maintenance of a replacement of the Municipal Property Register. Moreover, the municipalities will have general benefits of the new real property data infrastructure. The redesign of the business processes across registers saves personnel costs and contributes positively to the business case.

The register authorities are accountable for the IT-system investments

## 2.2.2 Establishing the Basic Data Program

As mentioned the “*property data initiative*” was not the only eGovernment Strategy initiative to be investigated. In parallel, six other basic data initiatives were analyzed including initiatives on: Addresses; Digital Elevation Model; Free geographical data, Person Data, Business Data and Data Distribution.

The business cases of each investigated initiative were compiled into a grand total business case. This business case was negotiated by the Min. of Finance and the Local Governments of Denmark (representing the 98 municipalities).

The **Danish Basic Data Program** organizes the seven initiatives. Each initiative is organized as individual sub-programs or projects. The basic data program coordinates the activities of the subprograms and projects. The overall objective of the basic data program is to ensure the efficient use of public primary data through improved quality, free access and joint distribution of data.

In October 2012, the board of ministers finally approved the business case and the property data initiative shifted status and became a program: the **Real Property Data Program (RPDP)**.

The Basic Data Program is afterwards supplied with a sub-program with objective to provide standards and guidelines on data modelling and other IT-architecture issues.

The sub-program on Data Distribution is responsible for establishing the so called *Data Distributor* for provision of joint distribution of basic data across the Basic Data Program. This means that the RPDP will disseminate real property information via the *Data Distributor*.

In December 2015, McKinsey & Company reviewed the Danish Basic Data Program. Quotes from the executive summary of this review:

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- The Basic Data Program is progressing to meet the mark against its vision but incentive structure, governance, and information flow will require increased focus to deliver full potential.
- From an international perspective, the Basic Data Program is a unique and ambitious program with no comparable peers.
- Going forward, the program should consolidate and realize benefits before deciding on future capabilities to develop.

### **3. THE REAL PROPERTY DATA PROGRAM (RPDP)**

#### **3.1 Scope of program**

Fortunately, the preliminary investigations have been rather detailed in the descriptions of tasks to be carried out. This was a great help for developing the terms of references (ToR) of the RPDP. The scope of work is defined in the agreed ToR and approved by the responsible ministers. The ToR delegates responsibilities to the participating bodies and provides clear descriptions of the specific tasks to be carried out.

##### **3.1.1 Resolving technical interoperability barriers**

The tax authorities and local governments for property valuation and the calculation of property tax will use information on properties, buildings and their owners in the property data registers. This makes the Municipal Property Register (ESR) redundant and after the transition to property data registers, the municipalities will therefore abandon maintaining the ESR.

A new register “Property Ownership Register” will be established to compensate for the fact that ESR will not be available for information of property owners.

A new unique property identification called BFE number will be established and used in the four property registers.

The Land Registry hands over the basic registration of condominiums and building on leased land to the Land Cadastre. This means that Land Cadastre will be responsible for the basic registration of all real property types: “Land parcels”, “condominiums” and “buildings on leased land”.

The RPDP impact on the central interoperability parameters is summarized in the below table.

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<b>Register</b>	<b>Real property term</b>	<b>Property ID</b>	<b>Property types in the register</b>
Land Cadastre	Cadastre property	BFE-no (unique)	Land parcel(s) Condominium Building on leased land
Land Registry	Cadastre property	BFE-no (unique)	Land parcel(s) Condominium Building on leased land
Property Ownership Register	Cadastre property	BFE-no (unique)	Land parcel(s) Condominium Building on leased land
Building Cadastre	Cadastre property	BFE-no (unique)	Land parcel(s) Condominium Building on leased land

**Table 2: The RPDP makes the property infrastructure more consistent with respect to property identification, property terminology and data recorded in the registers.**

Basic data on properties and their owners in the Land Cadastre, Building Cadastre and the new Property Ownership Register will be disseminated via the Data Distributor and can be freely used by authorities and private for commercial as well as non-commercial purposes.

The Data Distributor will be based on a service and event-driven architecture. This will allow users to subscribe on specific events and receive real time notifications on data changes.

### **3.1.2 Resolving organizational and financial interoperability barriers**

The organizational and financial issues mentioned in section 3.1.2 are all resolved.

The participating property registers neither individually nor as a group could establish the required funding and commitment to enforce the above infrastructure changes.

The organizational and financial issues were resolved because RPDP was approved at the highest political level. The RPDP from the beginning enjoyed political attention because the program implements the property data initiative of the Danish eGovernment strategy. Finally, the Min. of Finance provided the RPDP with the necessary political and financial scope that made the program possible.

## **3.2 Organization**

Danish parliamentary elections have led to a change of Government, which is the reason why the responsibility of the real property registers and the RPDP program management have moved to other ministries/agencies. The RPDP organizes the six projects:

- Four property register projects: 1) Land Cadastre; 2) Building Cadastre; 3) Property Ownership Register and 4) Land Registry.

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- Test project: Quality assurance, test planning and executing tests on transverse integration services.
- Law project: Development of necessary changes to the legislation to legalize the register modifications.

The participating bodies and their responsibilities:

- Agency for Data Supply and Efficiency: Program management, Test project and Law Project
- Agency for Digitisation: Over all responsible for the Basic Data Program
- Geodata Agency: Land Cadastre project and Property Ownership Register project
- Min. of Taxation: Building Cadastre project
- Land Registration Court: Land Registry project
- Local Governments of Denmark: Principal user of property information for land taxation and other purposes
- Min. of Taxation: Principal user of property information for property evaluation purpose

The private sector is continuously informed and involved so they can prepare for their operations. The financial sector, state agents, lawyers, and other real property market stakeholders are members of the RPDP professional users' forum, which meets quarterly. Moreover, the financial sector is involved in test preparations.

### **3.3 On the implementation of the RPDP**

The RPDP applies a business-focused approach in the implementation of the agreed infrastructure improvements and IT-system updates. The estimated economic gain related to the program implementation relies on the assumption that business processes using the data infrastructure are more efficiently performed. This requires that the business processes are considered a whole and across registers. Traditionally, the registers have focused on internal processes and have devoted little attention to the transverse processes that are connecting the registers. A key issue for the RPDP, in collaboration with the registers, is to establish a mutual understanding of the transverse business processes.

#### **3.3.1 Managing system architecture components**

Management of system architecture is an iterative process. After each iteration, the involved people reach a higher level of understanding, while the maturity of the program and its projects increases. During this process, it is important to have firm agreements on the achievements. Figure 1 illustrates the iterations from the lowest level of maturity to the stage where the project fully understands the process.

The first iteration defines the business processes and establishes an overview of the terminology involved in the processes. Hereafter the needs of IT-support are brought into consideration. The second iteration focuses on the transverse business processes and the information needed for these processes. Furthermore, the high level of IT-system integrations are analyzed.

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The first two iterations aim at establishing an agreed-upon stakeholder view. This view is described in the target architecture document. In this context, the stakeholders are the collaborating property registers and representatives of major data users, i.e. municipal and tax authorities. The target architecture is a key program management document to be agreed by the program steering committee.

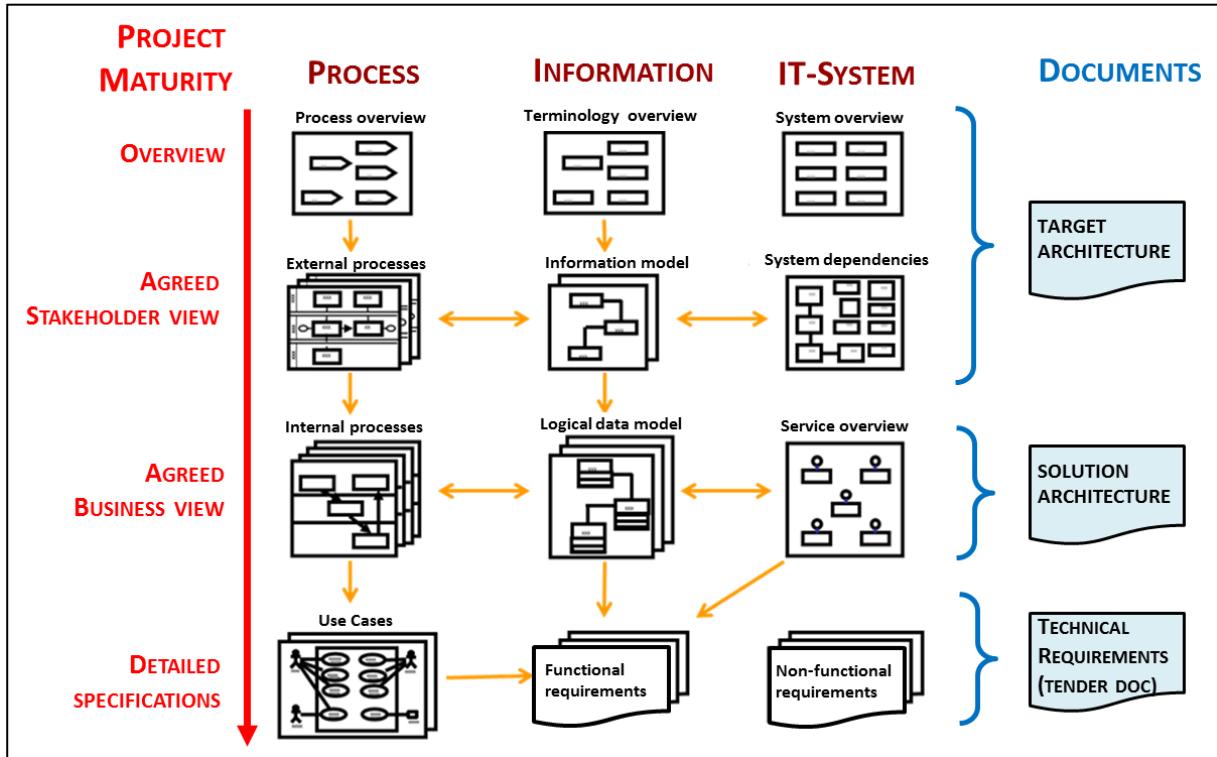


Figure 1: Management of system architecture components

The third iteration aims at establishing an agreed view on the internal system architecture of each register. On basis of the target architecture, each register project develops the solution architecture for that particular register. The solution architecture comprises descriptions of the registers: internal processes, logical data model and service integrations. The register projects are accountable for the solution architecture documentation; however, the RPDP shall agree on the service integration descriptions.

The fourth iteration establishes the registers' details system specifications and technical requirements for the later tender process.

The described process with four iterations appears to be a straight-forward progression. In reality, each iteration requires more rounds for completion. Similarly, there will be back loops because changes at lower levels shall be reflected in higher-level documents.

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At the time of writing, the RPDP and the associated registers have completed the above iterative process and the IT-system developments are in progress. The above approach has proven to be powerful for managing joint system architectures in programs with parallel IT-system developments. The approach has also been useful for change management purposes.

### 3.3.2 Data cleansing

The RPDP introduces the cadastral BFE-number as new property identifier to be used in four basic registers. BFE-numbers will replace the existing identifiers used in property ownership registrations, Building Cadastre and Land Registry.

The property registers property records have been compared and matched for identification of possible data inconsistencies. Afterwards, a comprehensive data cleansing has been performed to improve the data quality of property registers: errors are corrected, irrelevant information is removed, and missing data is supplied.

## 4. CONCLUDING REMARKS

Since the RPDP is still in progress and critical milestones are ahead, it is too early to draw final conclusions on the program achievements.

Thanks to the eGovernment initiative on the property data infrastructure and the support from the Basic Data Program, the RPDP has successfully removed the barriers that hinder interoperability improvement of the infrastructure.

In collaboration with the participating property data registers and the Basic Data Program, the RPDP has developed technical solutions to improve the interoperability. These solutions will be implemented in registers.

However, the technical achievements are only a step stone towards the ultimate goal of RPDP: the realization of the business case. The business case assumes that basic property data registers are sufficient to substitute the Municipal Property Register. For the program has therefore been a severe issue to priorities of the Municipal business interests. This conflicts from time to time with the registers' interests to stick to their own core businesses.

### 4.1 Upcoming challenges

The PRDP is on schedule and the basic real property registers are expected in operation by May 2017.

Towards May 2017, the RPDP are facing the following major challenges:

- Establishing a consistent test data population in seven basic data registers: *Production data will be converted to the registers' new data models and assigned BFE-numbers.*

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- Test of interfaces: *The register projects establish several web services and event messaging service on the Data Distributor. These service interfaces shall be successfully tested prior to integration tests.*
- Integration tests: The PRPD traverse business operations of the basic registers are subject to tests. *These tests include register-to-register data updates and event handling.*
- Users’ tests: *seven basic data registers participate in end-to-end tests together with the Municipal Land Taxation System and State Land Valuation System.*
- Final installation: *Installation of property registers in production environments. Nationwide data conversion, including assignment of BFE-number, and data upload to the Data Distributor*

## ACKNOWLEDGMENTS

I want to thank my colleague at the Agency for Data Supply and Efficiency Mr Jørgen Skrubbeltrang for fruitful collaboration.

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## BIOGRAPHICAL NOTES

### Background

- MSc. in geodesy, cadastral science and planning, University of Aalborg, Denmark.
- Postgraduate studies in computer science.
- Licensed to conduct cadastral surveys in Denmark.
- Member of the Danish Association of Chartered Surveyors, Denmark

### Brief career history:

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- 2009 – date Senior advisor at Agency for Data Supply and Efficiency, the Min. of Housing, Urban and Rural Affairs and Enterprise and Construction Authority, Denmark.  
Responsibilities: Program manager and leading the implementation of the Real Property Data Program.
- 1993 – date Partner and senior consultant of the independent consulting firm Regis, Denmark.  
Experience: Consultant to various cadastral, land registration and address projects mainly in Eastern Europe, but has also operated in CIS-countries, Africa and South America.

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