MINUTES

Decision date

2001-12-21

Present:

Joakim Ollén	Director General	*Deciding*
Lars Jansson	Director	
Stig Jönsson	Director	
Hans-Erik Wiberg	Director	
Clas-Göran Persson	IT Manager	
Per-Anders Karlgren	IT-co-ordinator, Land and Geographic Information	*Reporting*

A§ 1112 Direction concerning integration and development of Lantmäteriet's base-data and technical systems for information services.

Lantmäteriet (the National Land Survey of Sweden) decides that technical solutions for management of basic information shall have the direction described in the appended memo "The avenue of our choice".

The fundamental principles are:

- information management shall be based on object-oriented processes, methods and solutions
- system architecture shall be based on standards and a multitiered solution, and meet requirements as to robustness, openness, scalability and portability.

The overall objective is to create co-operating information systems in the infrastructure that handles Lantmäteriet's basic information, and to provide good conditions for provision and refining of data.

Expected effects are:

- that Lantmäteriet becomes the leading and guiding force in the development of the Swedish infrastructure for geographic information and real property information
- simple and efficient information management
- cost-effective development and maintenance of systems
- high quality of data.

The decided concept requires the following basic work to be carried out initially:

- Determination of which objects and attributes that are part of Lantmäteriet's information service.
- Description of different areas where the objects are utilised and the processes from source to provision.
- Continued object-oriented information modelling.

The responsibility for realisation of the decisions rests mainly with Land and Geographic Information and the IT-network. The realisation will be planned and budgeted for during the annual planning process.

A draft of this decision has gained approval by the co-decision group.

Lantmäteriet
National Land Survey of Sweden

2001-12-03

DECISION ON DIRECTION
Appendix to A§ 1112

The avenue of our choice

Integration and development of Lantmäteriet's base data and technical systems for information services.

1 Introduction

This document contains a number of statements and proposals concerning the continued development of information infrastructure and technical systems for the core process Information Services.

The proposed direction is fully consistent with the visions and strategies outlined in VVV 2006 and Vision 2004 . The proposals are based on analysis of the visions and strategic choices accounted for in these documents.

The objective is to simplify and to make more efficient the management of Lantmäteriet's basic data, and to create good conditions for the refinement market.

The **basic data** that are handled by Lantmäteriet consists of **geographic information** and **real property information**. This document does not deal with basic data stored in raster format.

The technical solution shall support an object-oriented process from updating and maintenance up to provision of information.

The benefit for the customer is that Lantmäteriet can provide well defined, up-to-date information at the very moment when it is needed. Customers choosing to keep own copies of data will be offered simplified updating procedures and thus get possibilities to make their information management more efficient.

Metria and those customers of Lantmäteriet who provide products based on Lantmäteriet's basic data will get the opportunity to simplify adjustments of their product line with respect to new requirements and they will be able to offer new products faster.

Lantmäteriet's migration to object-oriented information management is a prerequisite for open co-operation with other organisations and for the realisation of a distributed maintenance of information. It also provides one of the necessary conditions for a future creation of a new and even better Trossen.

Some keywords for the technical architecture are: robustness, openness, scalability and portability. Chosen solutions are at the front edge of the technical development. During the realisation period we will see the world around us adopting the same technique, although with a slightly different design depending on the supplier who provides the technical solution.

A list with definitions and abbreviations can be found in an appendix to the document.

2 Positions on strategic issues

An architecture with <u>one</u> logically coherent information system for geographic information and real property information.

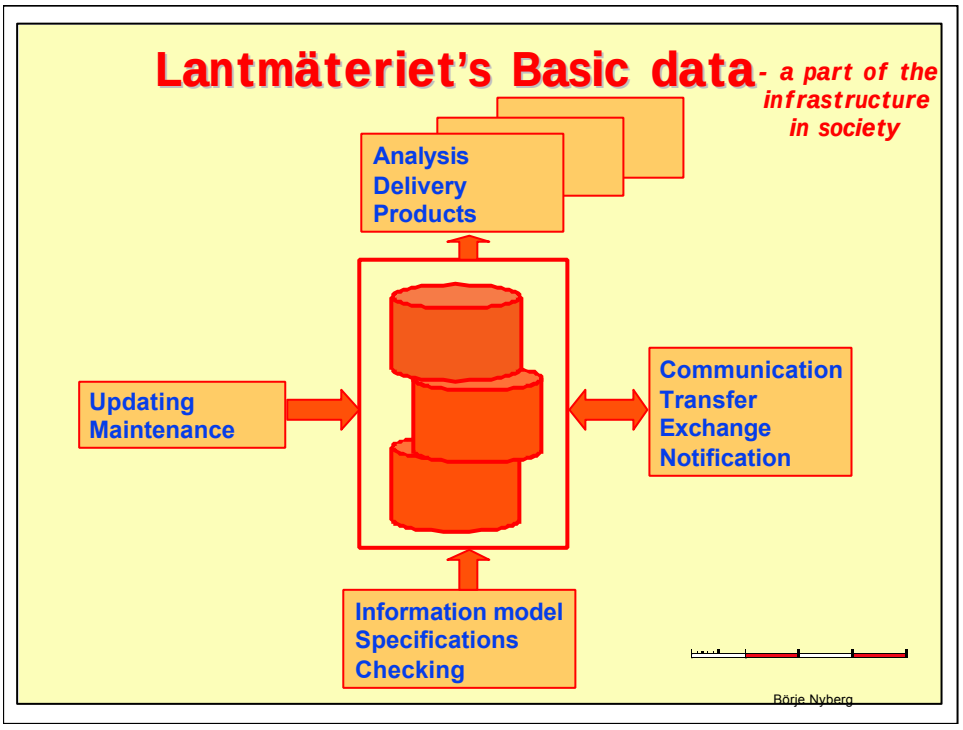

Figure 1. A logically coherent information system

The objective is to create *one* logically coherent system environment for all information – geographic information and real property information – in Lantmäteriet's information service.

The purpose of a unified solution is to ensure that storage, quality control and management of all data can be done in a coherent system thereby

avoiding internal copying and special procedures for synchronisation of data. The objective for Lantmäteriet's information maintenance systems should be not to duplicate storage of any data.

The new storage system shall be able to store and handle all kinds of data in an integrated manner. With the database technique of today the same database system can be used to store: register data, measurement data, geo-objects, networks, raster, images, documents and Metadata.

An integrated storage environment is a prerequisite for a well functioning information service and for the development of new integrated applications. It also provides better possibilities for efficient information management with synchronised and quality checked data.

The principle with an integrated system environment does not prevent internal storage of data in physically separated units or databases, for instance with different themes or because of security or performance reasons.

A separation of systems and data for
- **maintenance, and for**
- **analysis and provision**

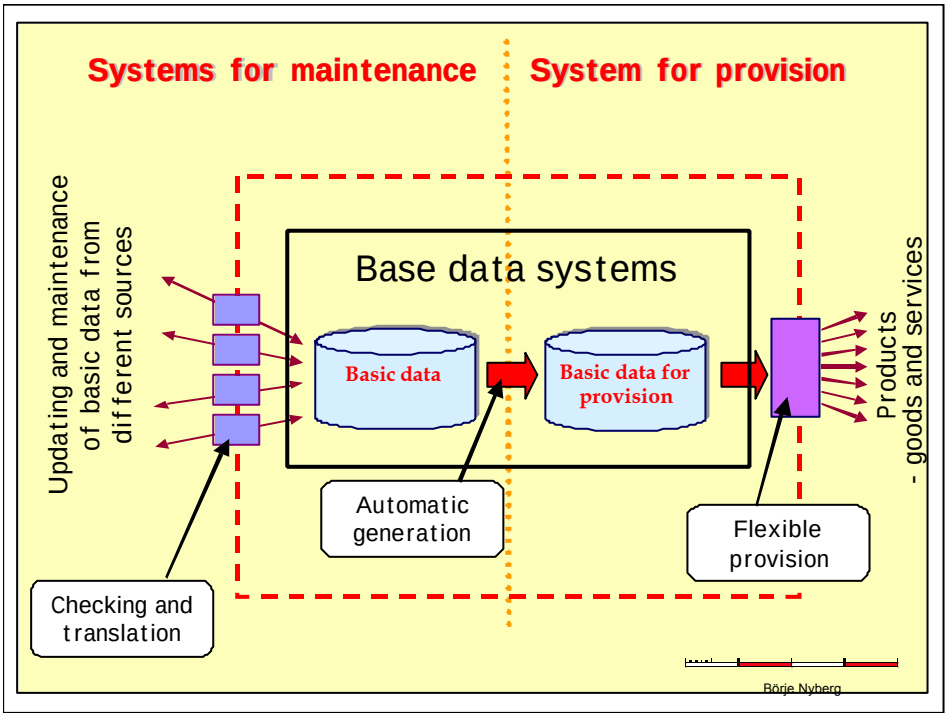

Figure 2. Within the framework of a logically coherent system there is a physical separation of systems for maintenance of data, and systems for provision of data.

Within the framework of a logically coherent base data system there is a physical separation of systems for maintenance of data, and systems for analysis and provision of data. This separation of the internal system in

two parts depends primarily on different requirements as to security, accessibility and performance.

Systems for provision of data usually need to be optimised and adapted for extraction of data or for analysis and presentation of data covering large geographic areas. Some restructuring of data may also be necessary in order for them to suit certain services or standardised products. To store these data in separate databases for provision will improve the conditions for information and database managers to adjust data structure (i.a. layer division), indexing and performance settings.

The transfer of base data to the system for provision of data *must* – to a greater extent than today – be done with efficient and automated processes and procedures. With regard to the requirements of each kind of information, data can be replicated, filtrated, restructured or in any other way transferred to the data storage by means of safe procedures for generation.

Data intended for provision also appear in variants adjusted for different products. It could, for instance, concern different levels of generalisation in order to facilitate production of maps to different scales.

A uniform concept for maintenance of data.

A uniform technical concept shall be used for updating and maintenance of information from different internal and external sources, including checking procedures and translation to the internal base data system. Still, different interface applications can be developed and adjusted for each purpose. See figure 2.

It must be possible to maintain the central databases directly but also by means of data in distributed systems (distributes maintenance).

The design and description of a concept for maintenance of data is one of the tasks in the continued development work.

A flexible concept for provision of data.

The demands for development of new products and services will vary over time. The objective is to build as uniform, but also flexible, systems and interfaces as possible for extraction and adapted provision of data. See figure 2.

Standardised and agreed models for exchange of information, and unique identifiers for all objects are the basis for notifications, event controlled exchange of data, and transfer of mere changes – irrespective of which attributes have been changed.

The system shall support provision of data adjusted to the users' needs and offer increased degree of self-service. It shall also create good conditions for the refinement market.

System independent models for all information.

All business information shall be described and structured in object based information models that are independent of the IT-system in which they will be implemented. Each object handled by Lantmäteriet will only appear in *one*, common information model.

Also, exchange (import/export) of data is based on system independent and object-oriented information models. Thus, these models must be harmonised with other businesses and be standardised together with other actors in order for them to communicate with external systems and exchange information as efficient as possible. By "mapping" these models against Lantmäteriet's internal information models and systems it will be possible to simplify the exchange of information. A basic principle is to use whole business objects as the smallest component. The object-oriented approach also provides good preconditions for the creation of good technical solutions.

The idea about model based exchange of information is behind the international standardisation work within ISO and the concept for co-operation between Lantmäteriet and the municipalities.

The use of object- and model-based exchange of information with agreed models and formats for exchange will remove the need for separate intermediary systems.

Managing data on our business as objects – business objects.

An object-oriented system is based on co-operating objects and a direct simulation of the business, i.e. reality adjusted to a certain purpose. Objects *contain* geometry (none, many). Thus, geometry is one of several attributes possible to connect to an object.

With business objects we mean the different kinds of objects in the business (such as real property unit, building, address, road, moor, lake) with built in methods, rules and relations. It is the methods of the objects that control what can be done through different applications.

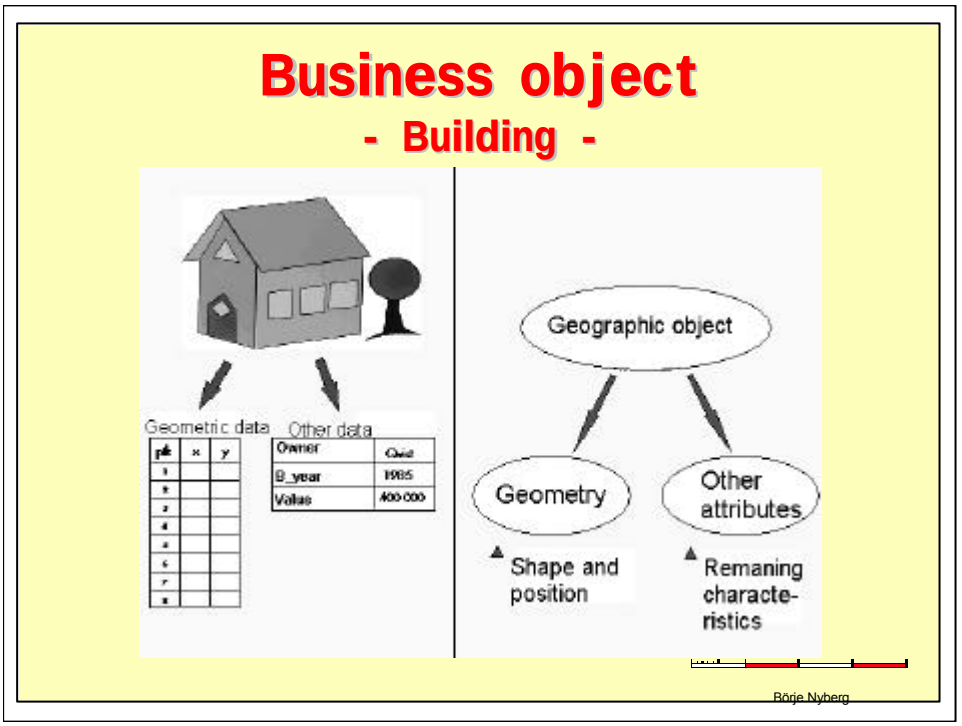

Figure 3. Example of a business object with geometry and other attributes.

When searching and analysing one has direct access to the whole range of attribute data – also the geometry. The result can be presented in the way one desire, for instance as a map or as a register extract.

This allows the users to work with the business concepts in their own IT-environments. It also means that some procedures and checks, today performed by users and applications, will be transferred to the system and its inherent logic.

Very simplified, one can say that today we use separate systems to store simple data that are being processed in complex applications. We wish to change this and use common systems to store "smart data" that are by routine construed to well-defined business objects. On that foundation we can in a more effective way develop applications and products meeting the users' requirements.

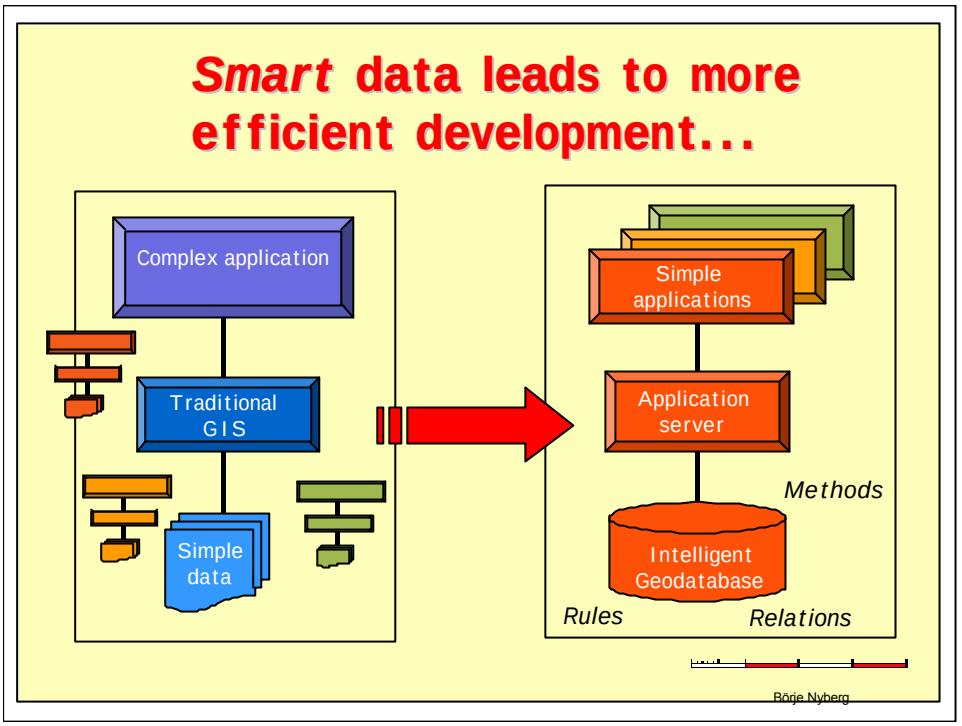

Figure 4. Smart data

A class library used by several applications must be maintained in one and only one place.

Systems development with object-oriented methods and tools.

Object-oriented methods and object-oriented development offer great advantages, particularly when it comes to reuse and maintenance.

In addition to modelling of business objects it is necessary that Lantmäteriet carries out a co-ordinated migration to object-oriented system development on a broad front. We have already good experience from this, but it involves considerable change in thinking patterns both for developers and for those in business activities.

The new thing is not the designing of models and the depiction of reality as objects but the fact that there are now methods, programming languages and technical systems available to realise the information model in an integrated IT-system.

Object-oriented systems development is done in close co-operation between information owner, business activities and developers. This co-operation requires support from a common modelling language and process tools.

The work method is: use-case driven, object-oriented, component-oriented, phased and iterative. This will require changes in Lantmäteriet's model for systems development.

An important objective is to reduce the costs for development and maintenance. Object-oriented systems development with increased reuse of written code is one way to achieve this.

The total system contains several layers.

The system architecture shall roughly have three logical levels: the presentation layer, the business layer and the database layer.

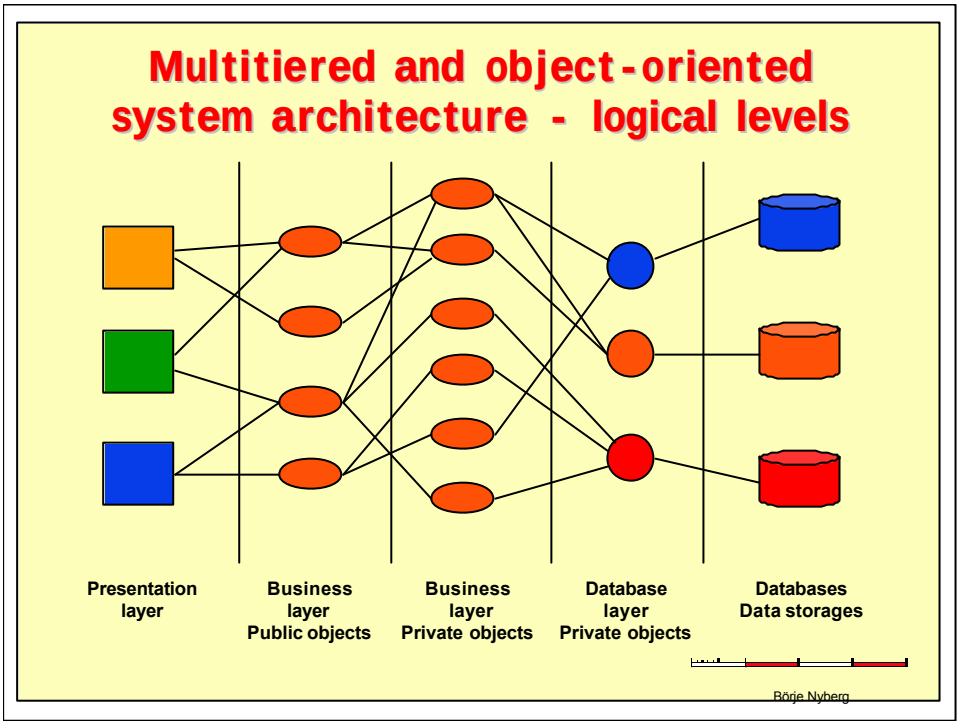

Figure 5. Multitiered and object-oriented architecture.

The presentation of data and the user dialogue is managed by the presentation layer. Here one can find anything from thin clients to parts of advanced tools such as ArcCadastre.

On the middle level the object structure and business logic is gathered in class and component libraries divided into several layers depending on the nature of the objects.

The database layer ensures a uniform treatment of objects subject to storage or change.

The multitiered system architecture leads to increased co-utilisation and provides more freedom in development. In principle, a new application can be built irrespective of which database or data warehouse is being used for storage. In addition, there are better opportunities for incremental development and migration. The system concept shall manage to deal with several different sources of data and facilitate possible change to new types of database management systems.

The multitier solution also provides increased scalability with good possibilities to adjust performance. The different layers will be made as independent of each other as possible, i.a. by means of equivalent call methods.

It is required that all business and system components be gathered and maintained in common application servers. This facilitates the creation of new applications and client programmes.

The tiered structure puts new demands on the hardware systems. There is, for instance, need for separate computer systems for data storage, application level, and applications. Additional hardware requirements are generated by the fact that the systems for maintenance of data and for provision of data shall be kept separate. There is also need for a description of dependencies, connections and flows between Lantmäteriet's internal systems.

In the tiered architecture the scalability will be independent for each level. The system solution for a certain level will be controlled by the functional and operational requirements for that very level.

3 Choice of techniques

UML (Unified Modeling Language) is utilised for information modelling.

UML has become a de-facto standard for object-oriented development, i.a. for description of use-cases and information models. Therefore, UML shall be used as the common modelling language in Lantmäteriet.

Migration to relational database environment with Oracle as database management system.

The new system shall be based on storage in relational databases with Oracle as database management system. System integration and migration from existing systems takes place during a transition period.

The object orientation is realised by means of suitable component technique.

When converting information models to data models (object model and database/storage model) components are being created. We will primarily add new business components ourselves but also bought system components shall be handled and maintained in a co-ordinated manner.

Presently there are two main avenues for technical realisation: Microsoft-COM and Enterprise JavaBeans (EJB). According to statements from different suppliers these techniques can be co-utilised. However, this has to be verified. Both variants should be utilised because:

- It provides more freedom of action for development of scalable and portable solutions without direct binding to certain suppliers.
- We have already chosen COM for ArcCadastre with a great number of GI-adjusted components.
- There is great uncertainty as to Microsoft's operative environment (NT/XP) for large business critical information systems. COM can only be utilised in this environment.
- Java and EJB can be utilised in most operative systems and computer platforms. This provides greater openness and portability.

The overall objective of an integrated and co-ordinated information system must not be lost. The business objects must be kept consistent and available for the development of new applications irrespective of the component environment. Each separate case requires analysis of how and for what each of the techniques shall be utilised within Lantmäteriet.

4 Functional requirements

Here are some examples of functional requirements:

- In addition to a permission system with access control on database and application level, there shall be functions to restrict access both to themes and to geographical areas. User definitions shall be independent of Lantmäteriet's internal organisation.
- All business objects shall have identifiers that are unique and stable over time.
- There shall be methods to handle time related versions, historical and planned, with time markings and status for all included objects.
- Transformation algorithms shall be built in to permit maintenance of information with different original systems.
- The system shall in all parts be able to handle 2.5 dimensions (plan+height).
- ArcCadastre shall be one of several clients able to maintain data stored according to the new concept. It shall be possible to do this without any translation.

5 Quality requirements

Metadata and quality declarations are part of the basic data and shall be an available and integrated part of the flow of data. Some pieces of information are part of the objects while others are stored in a separate, central database.

Quality of data shall be maintained, i.a. by means of rule based methods built into the business objects.

6 Use of standards

The technical systems shall be developed by means of recognised standards.

The ISO-19100 series concerning geographic information shall be applied.

Reading, manipulation and writing in the databases shall be done in a standardised manner, for instance by means of SQL.

7 Verification project

There is need for a competence development and verification project to co-ordinate and develop knowledge, and to test and verify that proposed models, techniques and software work as expected. One of the important issues is to ensure that the results of the modelling projects (TIM, FIM etc.) can be realised.

Some general issues of great importance that have to be tested in Lantmäteriet's system and with our data are:

- Different database management systems and uniform mapping from the object structure.
- Co-utilisation of different application servers.
- Co-utilisation of the component techniques COM and EJB.
- Transfer of information models to data models.
- System test via some realistic use-cases.
- Identification of functional requirements. Test if chosen systems meet the requirements.

8 The avenue to follow – final words

The plan for transfer to the new system concept is based on a stepwise development and migration from today's systems. The results of the verification project will indicate how the new system can be best utilised from a technical point of view.

The new joint information system shall in the future replace all existing storage of basic data and also minimise the need of separate storage systems for different applications.

During a transitional period it may be motivated to retain some registers in the existing storage environment (for instance Rosam). In such cases it shall be possible to co-utilise these via a standardised interface (SQL) in the multitiered and object-based concept.

Since updating of an object-based programme can affect the database, it will be necessary to pay attention to and to analyse co-ordination of updating and migration to new version of programmes. Thus, there must be support for migration to new versions, for instance via metadata tables.

The decision on direction shall serve as support for long term adjustments of the hardware platforms in the information service process.

The direction points out new needs for competence development and training within certain areas. There will be some new tasks for the maintenance organisation such as maintenance of object descriptions and components.

9 The task force

A task force including the following persons has prepared the basis for decision:

Per-Anders Karlgren	Land and Geographic Information
Roger Ekman	Cadastral Services
Pär Jonsson	Metria
Göran Karlsson	Land and Geographic Information
Hans Lundberg	"
Börje Nyberg	"
Lars Sävmarker	"
Tommy Ljunggren	Information Technology (IT)
Olof Mårtensson	"
Pär Hollander	"

The study has been commissioned by Hans-Erik Wiberg and Clas-Göran Persson.

Appendix

Definitions and abbreviations

Basic data	Includes all *data* in Lantmäteriet's fundamental information service; data maintained from different sources, data for provision and analysis, and *Metadata*.
Class	A class classifies objects and describes what they have in common. For instance Building.
Client	The computer or programme that uses a certain service available at another computer (server). Client programme is a programme used for communication with another part of the same software residing on a fileserver, server software.
COM	Component Object Model. Microsoft's technique for handling of objects.
Data	Data is the concept for single values or particulars that are collected and handled. By means of knowledge data can be interpreted or processed and result in *information*.
Data model	System dependent logical description of how objects (object model) and data (database/storage model) are organised. See also *Information model*.
EJB	Enterprise JavaBeans. A type of *JavaBean* designed for execution on a server.
FIM	The project Information models for real property information.
Geo object	Shortname for geographic object, i.e. an object containing geographic attributes.
Geographic Information	Includes all information representing phenomena whose location in relation to the surface of earth is of particular interest. It is also called spatial information.
GI	*Geographic information*
GIS	Geographic Information Systems – computerised information systems for processing and analysis of geographic data.
Information	The meaning and interpretation of *data*.
Information model	System independent logical (conceptual) model describing *data*, with definitions of business objects and their relations.
ISO	International Organization for Standardization.
Java	Object oriented programming language from SUN Microsystems
JavaBeans	A component model based on *Java*. Permits the development of ready components that can be reused. See also *EJB*.
Metadata	Data defining and describing other *data* on an overall level. Part of *Basic data.*
Migration	Migration is to change technique in connection with addition of new functions or maintenance. A migration is carried out over a long period of time with less disturbances for the production.
Object	In object-oriented systems development an object is a unit of *data* and programme code. An object represents a thing or a phenomenon of a certain object type/*class*. Examples: the person Per Persson and lake Vänern.

	The term is also used as a designation for different phenomena corresponding to object types.
Real Property Information	Concerns all information, decisions and conditions referring to real property unit. It includes the geometrical description of the real property unit.
Relational database	Nowadays the most common type of database. A relational database (RDB) consists of tables with two or more columns. The value in one column, for instance Civic Registration Number, is used as a key and identifies a record (row) in the table. The same key can occur in other tables and in these cases data in the tables can be combined by means of what is called a join. The person who developed the technique, E F Codd, has established twelve strict rules for what can be considered to be a relational database.
Replication	Function controlled transfer and storage of identical information on two or more databases either for security reasons or in order to facilitate access.
SQL	Structured Query Language. Standardised language for defining operations in *(relational) databases.*
TIM	The project Information models for topographic data.
Trossen	Lantmäteriet's computerised system for the cadastral process. The system entails all moments in the process such as registration, processing, registration in the real property register, billing, and archiving.
UML	Unified Modeling Language. A modelling language.