Why is Interoperability of Data So Challenging?

Tarja MYLLYMÄKI and Tuomas KAUTTO, Finland

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SUMMARY

The dreams of interoperability of data have been expressed since the beginning of digitalisation. Still this is an issue in many occasions. Why the progress is so slow?

There have been developments within each domain as well as worldwide, at the European level and at national levels. The geographic information domain has been at the forefront of this work. Today, the influence and the pressure to find the benefits of interoperability within the national public sector has increased considerably. This brings new challenges for the geographic information domain.

This paper describes situations which has been recognised in practice while trying to promote the interoperability of public sector data at the national level in Finland, including some details of the new Finnish reference architecture for spatial data.

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1. BACKGROUND

The National Land Survey of Finland has a long history in providing web services. Since the beginning of this millennium, the focus of NLSF in all development of IT services has been to define data products and services which are achievable for client software. The standardisation work and progressiveness of international spatial data organisations have contributed to that aim.

Some years ago the aims of interoperability reached the national public sector (Kallela, Jari, 2016). The needs and the new regulations for interoperability in the national level are increasingly affecting the spatial data sector (figure 1).

In Finland, we have had the Act on Information Management Governance in Public Administration since 2011. We have accepted the renewed recommendations of interoperability in the beginning of 2017, which promote the enterprise architecture approach in the public sector. We have legislation concerning the services which support digitized services and the implementation is ongoing. The reference architecture for spatial data was accepted 2016. And the deadline to implement the INSPIRE Annex I theme specifications is at the end of 2017. Those are just few examples.

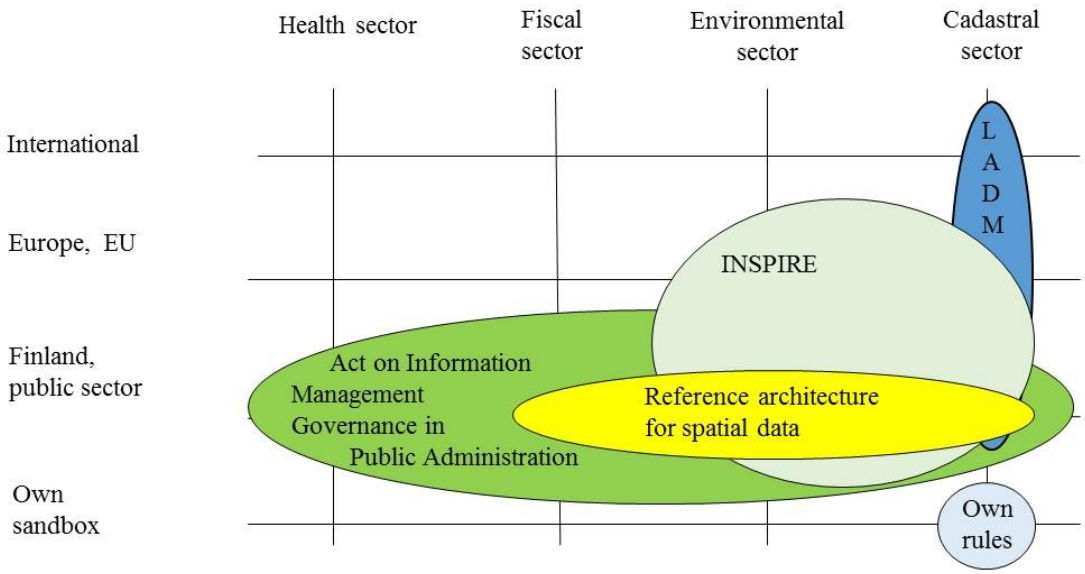

Figure 1. Interoperability regulations influence on different sectors and they can be conflicting

Now, by looking at a few cases, we can better see the challenges which are still ahead before interoperability is reached.

2. LEGISLATION

2.1 Act on Information Management Governance in the Public Administration

In Finland, the Act on Information Management Governance in the Public Administration (634/2011) obliges all the public administration organisations to plan and model their enterprise architecture and, once it has been planned, to comply with it. The purpose of the act is to improve public services and the efficiency of activities in public administration by laying down provisions on information management governance in public administration and on promoting and ensuring the interoperability of information systems.

According to the act, the general governance of information management for authorities in public administration is the task of the Ministry of Finance. Each ministry has the task of governing the development of information management and information management projects within their respective field of responsibility. The ministries must ensure that interoperability specifications and definitions are built and maintained.

2.2 National Architecture for Digital Services

In 2014 the Ministry of Finance started a new programme called National Architecture for Digital Services. One purpose of the programme is to improve shared use of information and the compatibility of information systems. The programme has developed common infrastructure services to utilize in both public and private sector organisations. One of the services is national data exchange layer which provides a standard and secure way to exchange data between organisations. The national data exchange layer has been developed and implemented in collaboration with Estonia. (Ministry of Finance, 2016b)

In July 2016, a new act on common administrative e-service support services (571/2016) came into effect. The act obliges public administration organisations to utilise common IT support services implemented in the National Architecture for Digital Services programme. One of those support services is a map service, which can be used in a standard way with modifiable content in software providing public services. All public authorities and also private operators when discharging public duties have the right to use the map service. (eSuomi.fi, 2017)

2.3 National regulations on spatial data

The European Union directive on spatial data (Infrastructure for Spatial Information in Europe, called INSPIRE) was enacted in 2007. The national laws (421/2009 and 421/2009) concerning the implementation of the directive were enacted in 2009. Now we are facing the first deadlines to implement the services for spatial data mentioned in Directive Annex I.

3. GUIDELINES

3.1 Recommendations

The Ministry of Finance has set up the Advisory Committee on Information Management in Public Administration (called JUHTA). It furthers the modernisation and adoption of operating practices and service production methods in public administration by utilising information and communication technologies.

The Committee has published a wide set of recommendations aiming to promote interoperability of data and information systems in the public sector. The most comprehensive recommendation concerning interoperability is the recommendation on enterprise architecture planning and development (JHS 179). The objective of the recommendation is to improve the interoperability of the activities and services of public administration organisations. The updated recommendation was published in February 2017.

The spatial data sector has been very active and it has participated in drafting recommendations. There are over ten recommendations concerning spatial data.

3.2 Enterprise architecture framework

TOGAF is an architecture framework based on best practices. It contains a method and a set of supporting tools for developing enterprise architecture. Systematically developed enterprise architecture improves efficiency, transparency, flexibility, reusability and interoperability of operations and information systems. (The Open Group, 2011)

This framework defines enterprise architecture as a composition of four architectural areas which form one interoperable whole:

- the business architecture (business strategy, governance, organization, and key business processes)
- the data architecture (logical and physical data assets and data management resources)
- the application architecture (blueprint for the applications, their interactions and relationships to the core business processes)
- the technology architecture (the logical software and hardware capabilities that are required to support the deployment of business, data, and application services)

The recommendation, JHS 179 Enterprise architecture planning and development, is based on TOGAF architecture framework and it is modified to suit for the Finnish public sector.

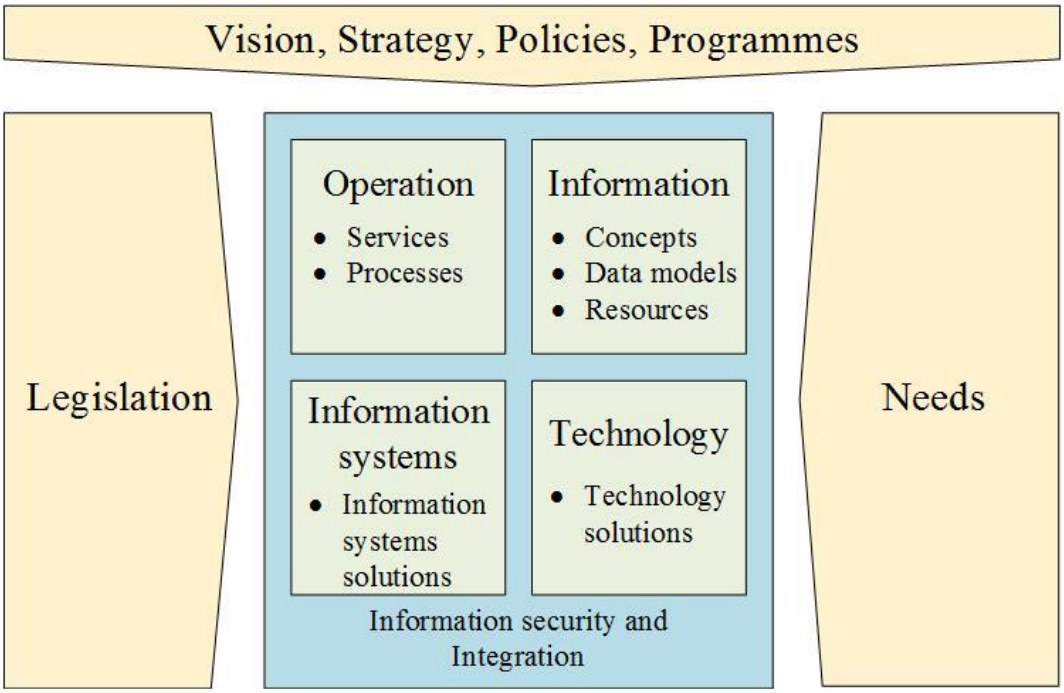

Figure 2. Enterprise Architecture approach in public sector

The drivers for enterprise architecture consists of both internal and external drivers. For example the long-term vision and strategy, policies for different sectors, government programmes, standards, legislation (in Finland and in EU), needs of citizens, companies and society are setting requirements to the development of operations. That said, the current status of operations, information, systems and technologies have to be taken into consideration (figure 2). (Ministry of Finance, 2016a)

By analysing both descriptions, the impacts of the transition from the current state to the target state will be resolved. The descriptions and models defined in the used architecture framework will help to recognise everything that needs to be taken into consideration. Results of the analysis can be used to plan a roadmap for implementing the needed changes.

3.3 Reference architecture for spatial data

The national reference architecture for spatial data was approved in autumn 2016. It unites the target architectures of both the public sector and the spatial data sector. Its content has been influenced by enterprise architecture works in the public sector and also by architectural solutions designed in INSPIRE architecture. It guides all enterprise architectural areas: business, data, application and technology architecture. (Ministry of Finance, 2016c)

The reference architecture of spatial data recognises the main challenges for data exchange in the four viewpoints of interoperability (figure 3).

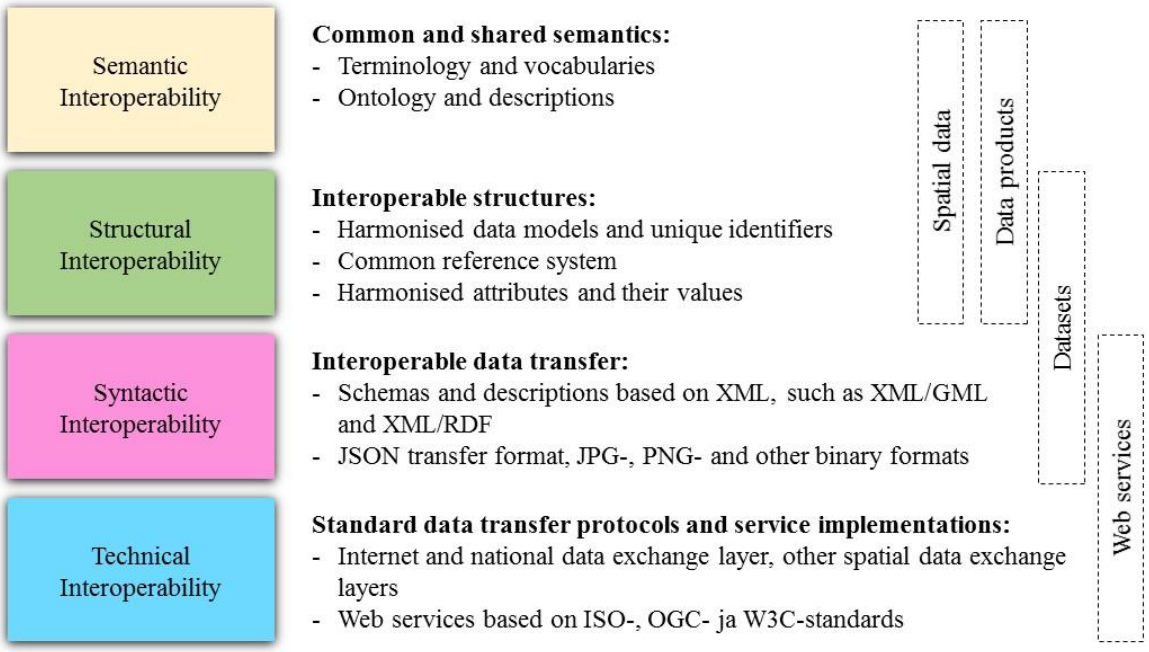

Figure 3. Viewpoints of the interoperability in the national reference architecture for spatial data

4. CASES

4.1 Case: Semantic Interoperability Framework and Workbench

One effort boosted by the Ministry of Finance to reach semantic interoperability is a project of semantic interoperability framework. It will establish a process and a method to ensure that shared definitions are applied in a systematic way and the semantics are passed to every implementation that re-uses the interoperability descriptions (figure 4). (Remes, Alonen, Maltusch, Hällström and Westman, 2016), (Alonen and Remes, 2016)

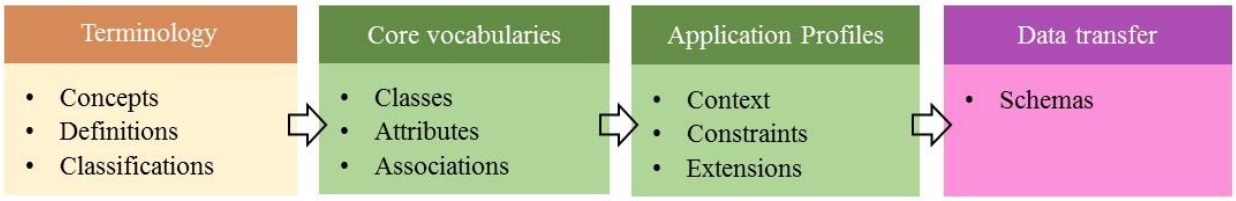

Figure 4. Development work is done to develop tools to support data modelling and reuse of resources.

The method has been published in an annex in the recommendation JHS 179. The use of the method is in a pilot phase, same with the tools supporting that work. The collaborative online tool for creating and documenting core vocabularies and application profiles is public and support interoperability in that way. (IT Center for Science Ltd, 2017)

This work will concern spatial data sector as a part of interoperability in the public sector.

4.2 Case: Model for a new service concerning limited liability housing companies

A big project where the enterprise architecture approach has been applied concerns the maintenance and services of limited liability housing companies. (Ministry of Agriculture and Forest, 2016), (Limited Liability Housing Companies Act, 1599/2009)

The planning project started with solving the drivers and backgrounds, interest groups, processes and concepts. One example of the work is the conceptual model of an apartment (figure 5).

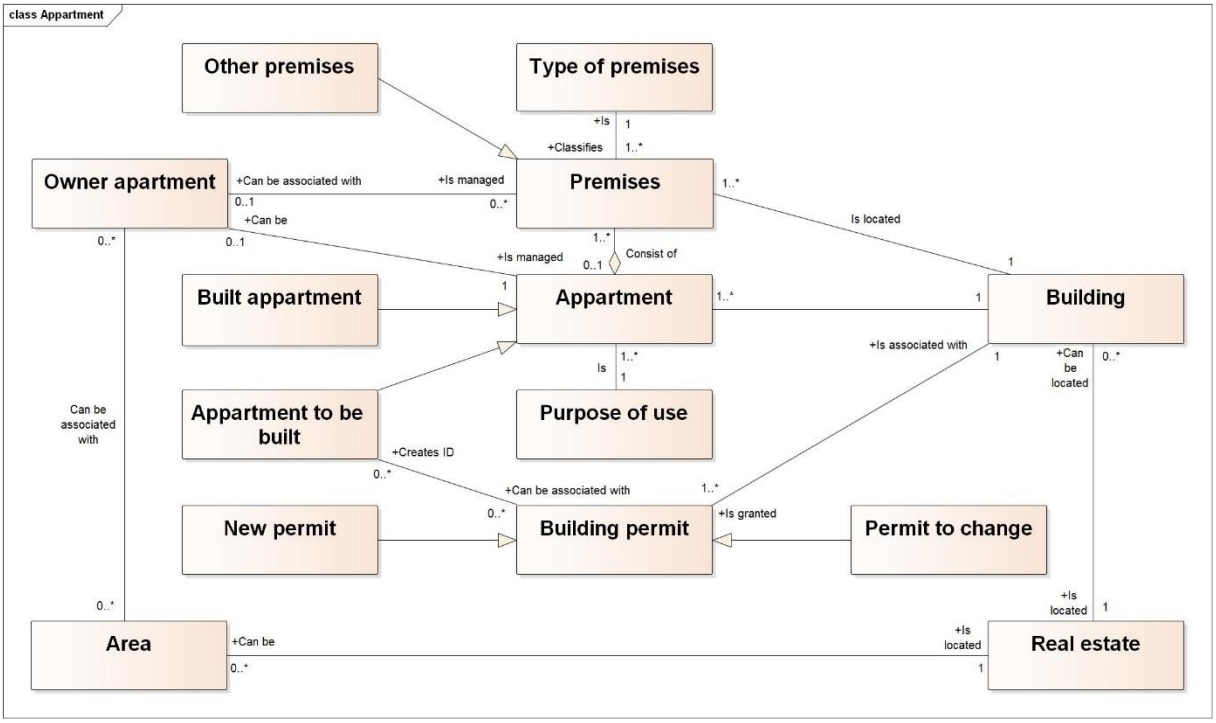

Figure 5. The conceptual model of an appartment, in the case of limited liability housing companies

4.3 Case: Conceptual model for spatial data services

The reference architecture for spatial data shows the conceptual model of a modular spatial data service (figure 6). It describes the relationships of the concepts, e.g. that one data product can be published in several web services and that we need descriptions at least for web services, data products and spatial data.

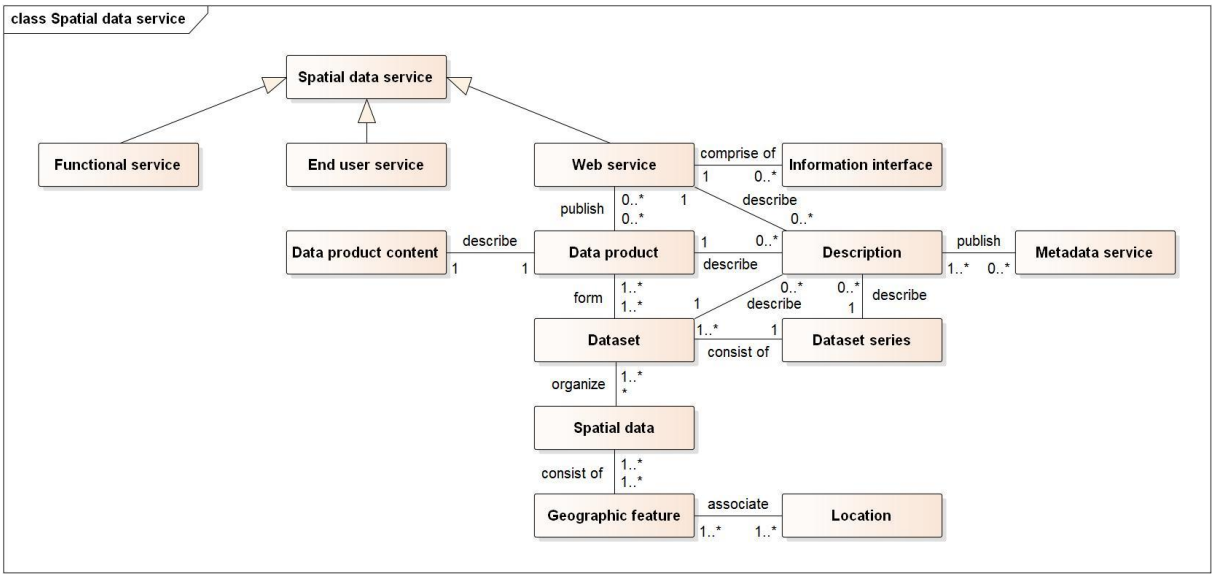

Figure 6. Conceptual model which describes the concepts related to spatial data service and the relationships of the concepts

To get interoperable services we need common concepts how to implement the services. These concepts should to be used in communication in the spatial data sector, but they are suitable for the other data services, too.

5. CHALLENGES

Public sector organisations have extremely large information systems and data assets. They are usually monolithic systems with long lifecycles, using varying technologies and they are complicated to integrate with each other. Data transfer has been implemented by copying data because others ways were not possible.

One trend in systems development is a distributed data management. It means that data is saved once and used from the same source by all systems. This adds pressure to solve and implement the unique identifiers, which is not a trivial matter to carry through.

After the solutions and processes have been implemented, it demands efforts to rationalise and modernise them. Changing data definitions and deploying a new version of technology are challenging tasks.

The on-line services which combine data from several data sources are not possible to implement without effectively accessible data offered by interoperable services.

5.1 Interoperable legislation?

The content and the concepts of legislation mirror the time it was enacted. A common problem is that development progresses faster than it takes to draft a law. The problems are emphasised today,

while digitalisation is increased and the need for interoperability between different domains and sectors is growing.

Efforts have been made to promote interoperability by legislation (see chapters 2.1 and 2.2). That said, attempting to accomplish interoperability by force is dubious. It might leave out some essential characteristics or at least is not so adaptable. If the rules are too detailed, applying the legislation becomes complicated. The rules in general laws can be inconsistent with special laws. This has been recognised with the laws concerning spatial data versus general laws (see chapters 2.2 and 2.3).

The limited scope of the law can be also problematic. For example the Act on Information Management Governance in the Public Administration mentions only the interoperability of information systems. True interoperability is based on concepts and information architecture. If the concepts are not interoperable, there will also probably be problems with interoperability and integration of the information systems.

There are many different information management concepts and definitions in the law in force. Some of the definitions may conflict with each other and some concepts are not defined precisely enough (e.g. “technical interface”). These conflicts and deficiencies make the application of the laws even more difficult.

To be noted:

- Pay regard to existing legislation.
- Use common and shared concepts and definitions in the legal text.
- Do not enact legislation with too many details. Do not include information system descriptions in the acts.

5.2 Same methods and tools?

Descriptions, even of the same object, represented with different models are difficult to compare. Comparing or merging the models or parts of them constructed by various tools is not possible if the tools cannot transfer the data in any common technical format. To represent descriptions and documentation to be used widely within the organisation and between organisations requires interoperable and shared methods and tools.

To learn and understand the use of a common method takes time and the will to do so. Often it needs a change in attitudes in the whole organisation. To get the shared architecture method widely used, the support of leadership is essential.

The tools and models used in the enterprise architecture work are crucially important in developing an interoperable and reusable whole of the description. Using the same models, standard notations and appropriate architecture modelling tools will facilitate the enterprise architecture work significantly. The modelling tools will also enable to handle large scale architecture repositories.

To be noted:

- Settle and use a shared architecture method.
- Insist on tools with transferability.
- Acquire support of leadership.
- Look for good examples. Start with pieces you can control.

5.3 Successful semantics?

Earlier processes and information systems were implemented on a case by case basis. So the concepts have been adopted for one use case and separately from other use cases. To achieve the interoperability we have to find consensus when defining meanings and contents of common concepts. The viewpoint in defining the concepts should be the processes and not the information systems.

Legislation and rules on what kind of data and how to collect it have changed during the long period when society has gathered the basic data of the public sector. Different information of the objects and attributes with unequal codes are true hidden problems. The harmonising of concepts is a demanding task, but it is a prerequisite for interoperability.

Conceptual model fulfils the semantic understanding. When attributes needed in a certain use case are given for the concepts, the model is called logical data model. Then, this model will be modified to suit the database software and is called model of the data store. The conceptual model, logical model, model of the data store and the models for data transfer alike can be modelled using the same tool, but they should not be confused with each other.

A project which deals with the Semantic Interoperability Framework and Workbench (see chapter 4.1) tries to solve this flow. The flow is remarkably consistent with the process used in the development process. The pilot phase will show if the purpose to manage all the common concepts and their realisations in different implementations done for various use cases will be possible.

In the case of limited liability housing companies project (see chapter 4.2), the concept model and the descriptions have been successfully used in communication with interest groups to receive consensus of the environment where and what the project should aim at. The progress in a limited time has also been remarkable. The enterprise architecture method has shown its potential in this project. The descriptions allow better basis for the implementation phase.

In the reference architecture for spatial data (see chapter 3.3, figure 3) was published the conceptual model which describes the concepts related to spatial data service and the relationships of the concepts. These concepts can be generalised and used in other public sector cases. Data product is a common concept within the spatial data sector, but new and unknown for the other sectors. While the need for interoperability is growing, adopting of these concepts helps the communication. The concept in figure 4 can be generalised to any service or data in the public sector.

To be noted:
- Agree upon common concepts. Use them.
- Be patient. Demand interoperable concepts.

6. CONCLUSION

There are several areas where interoperability should be implemented. During the evolution of our complex digital world we have met many problems and learned many lessons how one – small and seemingly insignificant – thing can prevent interoperability. Interoperability of data does not happen by chance.

Unfortunately, interoperability can be shown as a slide show in a very impressive way. And mentioned in speeches with dramatic words. These marketing tricks can be true or a myth.

Instead of marketing we should use methods which have been proved to be good and we should avoid to be innovative. By using the enterprise architecture method – as early as possible, as extensively as possible – we can create better conditions to achieve interoperability. In future we need it even more. Our entities and objects with unique identifiers will have properties both in the physical world and in the legal world. They also have information of the planning phase and retired phase. Lifecycles of data and information systems should be in control.

Iteration is a reality and we must accept it. For example in INSPIRE work, there will be a refit-phase when the process and its results will be reviewed to examine if they fulfil the needs of users and are conformable with the digital services in EU.

Principally, we need understanding between human beings who design our processes and where computers and software are only tools to conduct the process. The customer is the king and we are the servants.

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BIOGRAPHICAL NOTES

Tarja Myllymäki is a Master of Science (Surveying). She has worked at the National Land Survey of Finland since 1988 on several development projects. She has been involved in the INSPIRE thematic working group Cadastral Parcels set up by the European Union and ISO Land Administration Domain Model working group. For the last few years she has been involved with Enterprise Architecture. She has been the Finnish delegate to FIG Commission 3 since 1998.

Tuomas Kautto is a Master of Science (Computer science). He has worked at the National Land Survey of Finland since 2010 on the design and implementation of ICT infrastructure and on several development projects. Since 2014 he has worked as an Enterprise Architecture Coordinator. In 1997–2010 he worked in various positions at the University of Jyväskylä.

CONTACTS

Tarja Myllymäki
National Land Survey of Finland
P. O. Box 84
FI-00521 Helsinki
FINLAND
Tel. +358 29 530 1100
Email: firstname.lastname@nls.fi
Web site: www.maanmittauslaitos.fi/en

Tuomas Kautto
National Land Survey of Finland
P. O. Box 84
FI-00521 Helsinki
FINLAND
Tel. +358 29 530 1100
Email: firstname.lastname@nls.fi
Web site: www.maanmittauslaitos.fi/en