The Functionality of Conceptual Standards in the E-service Production Process

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Abstract
The paper presents a case study conducted at the Swedish Road Administration (the SRA) focussing on the RDS-TMC service, a type of e-service. The implementation of the RDS-TMC service is based on two conceptual standards: the ALERT-C and Location Code standards. The main purpose of the case study has been to understand the functionality (role) of these standards by investigating how the SRA has implemented and used the standards behind the RDS-TMC service in order to provide the service.

Keywords: Standards, Use, E-service, RDS-TMC service, work-practice

1 Background

When we talk about the use of information and communication technology (ICT) today, we often use the term 'service'. There are e.g. mobile positioning services, traffic information services and banking services on the Internet. With the help of channels such as the Internet and mobile telecommunications, services are produced by service providers using computer based information systems (IS) and information and communication technology (ICT). We use the term e-service to talk about these types of services in the paper. E-services are global, networked, ubiquitous and heterogeneous in their character which makes them complex to develop control and manage (Lyytinen and King, 2006). This is also an important factor that triggers the need for standards in the area. Today there are a number of standardisation initiatives in a number of e-service domains e.g. e-government (IDABC, 2006), Location Based Services (ISO/AWI:19132; 19134), e-mortgage (Mismo, 2005), health care (HL7, 2005), etc.

The transport sector is another example of an area where there is rapid development of new e-services. The concept used in the transport sector to talk about these services is Intelligent Transport Systems and Services (ITS). In the ITS-sector the use and implementation of standards are important, because the ITS-industry is global, networked and heterogeneous; and in order to deal with this complexity there is a need for standards which promote communication and interoperability between organisations, people and IS both on a national and international level. This is also the reason why a lot of money and work has been invested to develop standards in the ITS-sector (Bossom, et. al. 1999, ISO/PDTR 14813-13, CEN ENV 1377:2000). The aim of the standardisation process in the ITS-sector is to create interoperability between systems and services and to promote industrial development.

In the ICT-domain Jakobs (2003, p. 2) defines the notion of standard as:
"A publicly available definitive specification of procedures, rules and requirements, issued by a legitimated and recognised authority through voluntary consensus building observing due process, that establishes the baseline of a common understanding of what a given system and service should offer."

Standards have played an important role for the evolution of ICT (Lyytinen and King, 2006). As important as standards are for the ICT-field, there have been relatively few scholarly

papers on standardization informing the scholarly discussion in the ICT-field, and this is particularly true for the use of ICT-standards. West (2003, p.315) who has reviewed the research on ICT-standards claims that the adoption and use of standards has rarely been studied in the IS-field. This implies that the use of standards and the role they play in work-practices is a research area that is crucial to explore in the IS-field. The main purpose of our research is therefore is to explore how standards are used, and which functionality (or role) they can have in the e-service production process. This is of importance because standards usually are an implicit and unexamined aspect of the information systems artefact (West, 2003).

We also believe that the ITS-field is very suitable for this type of research. One reason for this is that the importance of standards and the large investments in standards in the ITS-sector makes the study of how these standards are used imperative; because the real value of the standards comes into play when they are implemented and used. Another reason why it is of interest to study the use of standards within the ITS-field is that it can give important insights into the challenges that the IS-field in general have to cope with in providing ubiquitous and mobile e-services, and which role the use of standards can have on this process.

The reason for choosing the **R**adio **D**ata **S**ystem-**T**raffic **M**essage **C**hannel (RDS-TMC) service is that it is based on two standards, ALERT-C and Location Code (ISO 14819-1:2003, ISO 14819-2:2003, ISO/TS 14819-3:2000). The RDS-TMC service is also the only mobile national language independent mobile traffic information service in Europe. The RDS-TMC service is in operation in Austria, Belgium, Denmark, Finland, France, Germany, Norway, Italy, The Netherlands, Spain, Sweden, Switzerland and the United Kingdom. Countries planning to provide the RDS-TMC service soon are, the Czech Republic, Hungary, Slovakia and Portugal (TMC-Forum 2006). RDS-TMC services is also in place in America, has been demonstrated in China and are under development for a number of other countries outside Europe. This implies that the standards that the service is based on have been used for a long time which makes it possible to examine experiences from the use of standards, and the role that they play for the service production process.

2 Standards and standardisation in the IS-field

2.1 Standards

From the definition quoted above we can see that ICT-standards are defined as a publicly available specification (document) of procedures, rules and requirements of what a given system or service should offer. This definition is a good starting-point for understanding the standard concept; however, in order to be able to understand the use of standards we have to understand the concept in more detail and in the context of information systems development and the production of e-services.

2.1.1 De jure and de facto standards

In the standardisation literature there is a distinction made between de jure and de facto standards. De jure standards are standards that have been developed and formally accepted by a formal procedure performed within a standardisation development organisation (SDO). This implies that the definition of the standard concept presented in chapter 1 above is foremost applicable to de jure standards. A de facto standard is a technique or method that has emerged as a solution to a problem which has been so commonly adopted that it can be considered as a standard. One typical example of a de facto standard in the ICT-field is Microsoft Windows.

2.1.2 Horizontal and vertical standards

In the ICT-literature (see e.g. Jain and Zhao, 2004) there is a distinction made between vertical and horizontal standards. Vertical standards (ibid.) or domain-specific standards (Stegwee and Rukanova, 2003) are standards that address business problems unique to a particular domain or industry. Horizontal standards are technology products and computer language standards such as COBOL, SQL, telecommunication protocols, Windows and XML, (Markus et. al., 2004). Vertical standards differ from horizontal standards because they are oriented towards a specific application area and that they address business and work-practice aspects rather than technical ones. Vertical standards have their focus on data structures, definitions, document formats and business processes. This implies that vertical standards are focused on the use of ICT not the ICT itself (Markus et. al., 2004).

This implies that vertical standards are oriented towards the semantics and the pragmatics of the communication and the meaning of the communicated messages, while horizontal standards are oriented towards the syntax structure of the communicated messages and technical levels. Examples of horizontal standards are the Health Level Seven (HL7, 2005) in the health care sector; and, the ALERT-C and Location Code standards which are the focus of this paper.

2.1.3 Conceptual standards

From the discussion above we can see that there is a difference between vertical and horizontal standards. Vertical standards contain requirements, descriptions and definitions which describe data structures, document formats, the functionality of information systems and the activities of business processes. In the IS-field these types of descriptions and requirements are usually called conceptual models and the process of creating these models is known as conceptual modelling (Wand et. al., 1995). Conceptual modelling in information systems development is the creation of conceptual models (or enterprise models) for the purpose of designing an information system. The fact that vertical standards to a great extent consist of conceptual models which are intended to be used as specifications and requirements for systems development, and the use of IS and ICT, is the reason why we in this paper prefer to use the term conceptual standards rather than vertical standards.

Today solutions are developed which support communication, collaboration and information exchange between people, organisations and information systems on a global basis (Hanseth and Lyytinen, 2004). Hanseth and Lyytinen (2004) claims that this is such a fundamental change that we have to start to talk about the development of infrastructures, not only the development of information systems (IS). An information infrastructure consists of an application infrastructure (an Information Systems Architecture, ISA) of several information systems exchanging information, and a support infrastructure (technical infrastructure). The support infrastructure supports the ISA, and can furthermore be divided into a transport infrastructure and a service infrastructure. The transport infrastructure e.g. TCP/IP is used for carry the information between partners and the service infrastructure provides additional support, e.g. the Domain Name service of the Internet.

Figure 1 below describes an Information Systems Architecture (ISA).

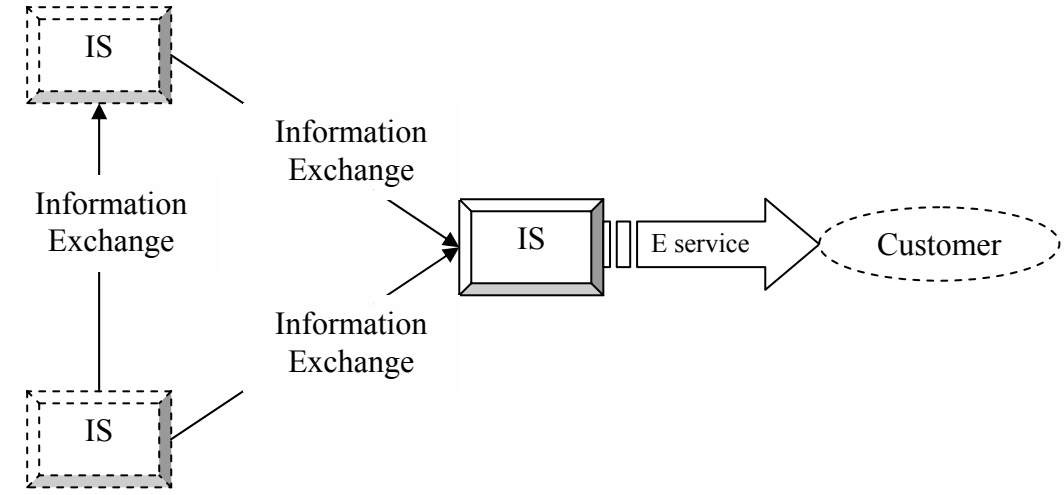

Fig. 1 Information Systems Architecture (ISA).

It is important to see standards as a basis for such an ISA, and that standards regulate communicative patterns (Hanseth, and Lyytinen, 2004). Information infrastructures also inscribe a certain pattern of use (Hanseth and Monterio, 1997). For example, an important part of the definition of standardised messages is deciding which data elements should be included in the messages and which should not. These elements govern what can be communicated when the standard is implemented. According to Hanseth and Monterio (2004) there is a wide variety of information infrastructure standards produced within bodies such as ISO/CEN, EDIFACT, and the Internet Society. These standards are of different levels and deal with issues such as message definitions, syntax specification, protocols, file type formats, etc.

2.2 The users of ICT-standards

A final goal of standardisation is that developed standards are used and implemented. An important idea in standardisation is that standards should be voluntarily used and implemented. This is the reason why Brunsson and Jacobsson (2000) consider users of standards as actors in line with how the concept is used in the Social Sciences. The users of horizontal ICT-standards are primarily actors, who are concerned with the technical implementation of IS, such as programmers and computer engineers. If we consider the users of conceptual standards, business and systems developers and end users will also be important standard user categories. Evans et. al. (1993) make a distinction between these categories of users of ICT-standards.

End users/terminal operators using the computer as a tool in their job.
System administrators who maintain the integrity of the IT environment.
Users who establish and maintain the IT environment.
Developers who develop a solution to a problem by making software and integrating systems.
Non human users i.e. information systems.

All these users use ICT-standards but will have different requirements. It is of interest to recognise that Evans et. al. (ibid.) do not consider the final customer as a user category for ICT-standards. This is line with (Aggarwal and Walden, 2004) who claim that end consumers

do not usually buy standards, but rather purchase a product in which the standards are embedded. It is the manufacturer who pays the licensing fees for standards which means that the users of standards in most cases are companies and organisations that produce IT-products.

2.3 Standard and standardization research in the ICT-field

Considering the importance of standardisation, the interest for research in the IS-field has been surprisingly modest (Lyytinen and King, 2006). Fomin et. al. (2003) describe three streams in standardisation research:

1. ICT standardisation as an innovation and product development process
2. ICT standardisation as a decision problem
3. ICT standardisation as a socio-technical process.

2.3.1 ICT standardisation as an innovation and product development process

The major research performed in this stream is how producers should organise an effective design process of technical specifications. The focus of this research stream is on the development process that results in specifications for a technical artefact, and the main question is how producers should organise their activities to enable an effective design of the standard.

2.3.2 ICT standardisation as a decision problem

A second stream of research describes standardisation as a decision problem focused on events and rationalities which guide standard related decisions among a set of producers. The main research question is to find out why producers choose a specific standard, and what would have been the most rational outcome for such a choice. Most of this research is inspired by economic theory such as switching costs and network externalities. The focus in the research is on how technology specifications emerge, and on factors that influence search and discovery. In this research the standards are considered as a black box containing technical specifications.

2.3.3 ICT standardisation as a socio-technical process

A third direction of research is socio-technical studies of standardisation. This research describes standardisation as a form of social interaction within a network of actors, in which the technology is introduced and stabilised in a social system. The main research question has been to explore why and how a specific ICT-standard has been created and what social and technical issues influenced its creation. Socio-technical research describes the process of the building of the socio-technical network related to the actors involved.

2.4 The chosen research stream

Each of these research streams offers their specific insights. Innovation process models are focused on the development of standards. Decision theory has a focus on adoption decisions. Finally socio-technical research has a focus on meaning, negotiation and actor enrolment in standardisation processes. However none of these streams look at standards from a work-practice perspective and the use of standards from such a perspective.

Consequently, the main reason for our research is to analyse the work-practice where standards are used. The main research question is to explore which role ICT-standards have and what makes them usable in work-practices which provides e-services. This is important because conceptual standards describe rules and guidelines for processes and products (Brunsson and Jakobsson, 2000). This implies that if standards are to be used they have to be

implemented in a work-practice in order to support the actions of the work-practice. The production of an e-service (e.g. the RDS-TMC service) can be seen as a work-practice, and it is the service provider or manufacturer that is the user of ICT-standards and not the end consumer (the client).

3 Research setting

The results presented in the paper have been based on a case study at the Swedish Road Administration (Vägverket in Swedish, abbreviated SRA in English). The SRA is the service provider responsible for the RDS-TMC service in Sweden, which has been in operation since 1997. The RDS-TMC service is based on a number of standards (ISO 14819-1:2003, ISO 14819-2:2003, ISO/TS 14819-3:2000), and the intended users of these standards are the service providers. Being the service provider of the RDS-TMC service in Sweden implies that the SRA has the responsibility to see that the service complies with these standards.

3.1 Purpose

The purpose of the research has been to investigate:
How the SRA has used the ALERT-C and Location Code standards to provide the RDS-TMS service and what impact the standards have had on the production of the RDS-TMC service.
Which functionality (or role) standards have for the production of e-services.
Purpose 1 is oriented towards the standards ALERT-C and Location Code and how they are used in producing the RDS-TMC service in Sweden.
The second purpose is of a more general character. The purpose here is to analyse and discuss what functionality (or role) conceptual standards can have on a general level in the production of e-services.

3.2 The research process

The figure below presents the research process and the methods used in this process:

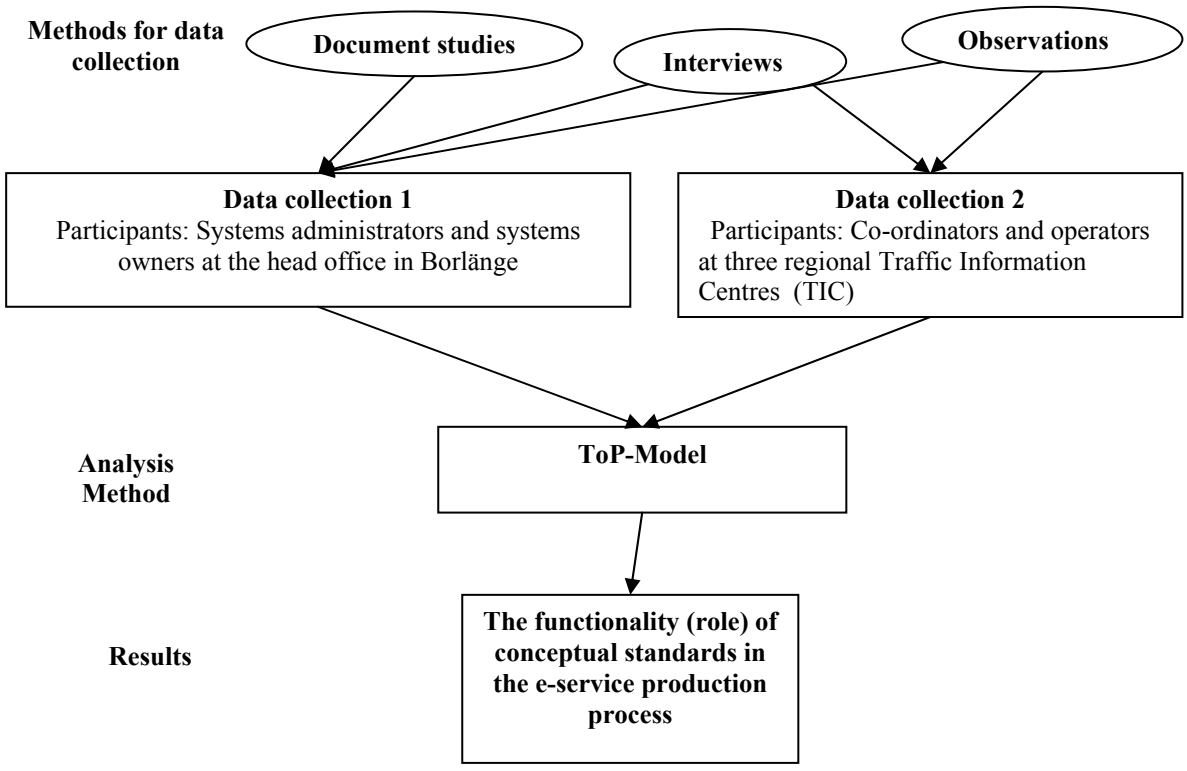

Figure. 2. The research process

3.2.1 Data collection

The data collection has been performed by:
1. Reading written documents which describe the standards and the information systems which are used to provide the RDS-TMC service. The documents are produced by the SRA, the European Committee for Standardization (CEN) and by the TMC Forum.
2. Observing how the systems have been used and examining the information content of databases.
3. Guided interviews which have been performed with people at the SRA headquarters and with people at three regional Traffic Information Centres (TIC).

The data collection was performed on two occasions.

Data collection 1 was performed at the headquarters of the SRA starting in the autumn of 2001 ending in the spring of 2002. The aim was to gather information in order to be able to describe the standards and the systems used to provide the RDS-TMC service. Five people were interviewed: two of those were systems administrators; two were systems owners of the systems used to provide the RDS-TMC service. The fifth person had been involved in the standards development process. As a complement to the interviews, document studies and observations were made.

Data collection 2 started in the autumn of 2002 and ended in the spring of 2003 and was performed at three Traffic Information Centres (TIC). The TIC are responsible for the operation of the RDS-TMC service on a daily basis. The purpose was to find out how the operators used the systems and the standards when they provide the RDS-TMC service. This data collection was based upon interviews and observations. The people interviewed were the operators at the TIC and the co-ordinator who is responsible for the TIC. There were 2-3 people participating at each TIC.

3.3 The Theory-of-Practice Model

The analysis of which role conceptual standards have for the production of the RDS-TMC at the SRA is based on the Theory of Practice (ToP-model) (Goldkuhl, 2005, Goldkul and Röstlinger, 2005). The ToP-model describes and acknowledges a work-practice as a production practice. The idea of a work-practice is based on the following definition:
"A work-practice means that some actor(s) - based on assignments from some actor(s) - makes something in favour of some actor(s), and sometimes against some actor(s), and this acting is based on material, immaterial and financial conditions and a work-practice ability which is established and can continuously be changed."

The ToP-model is described in the figure below.

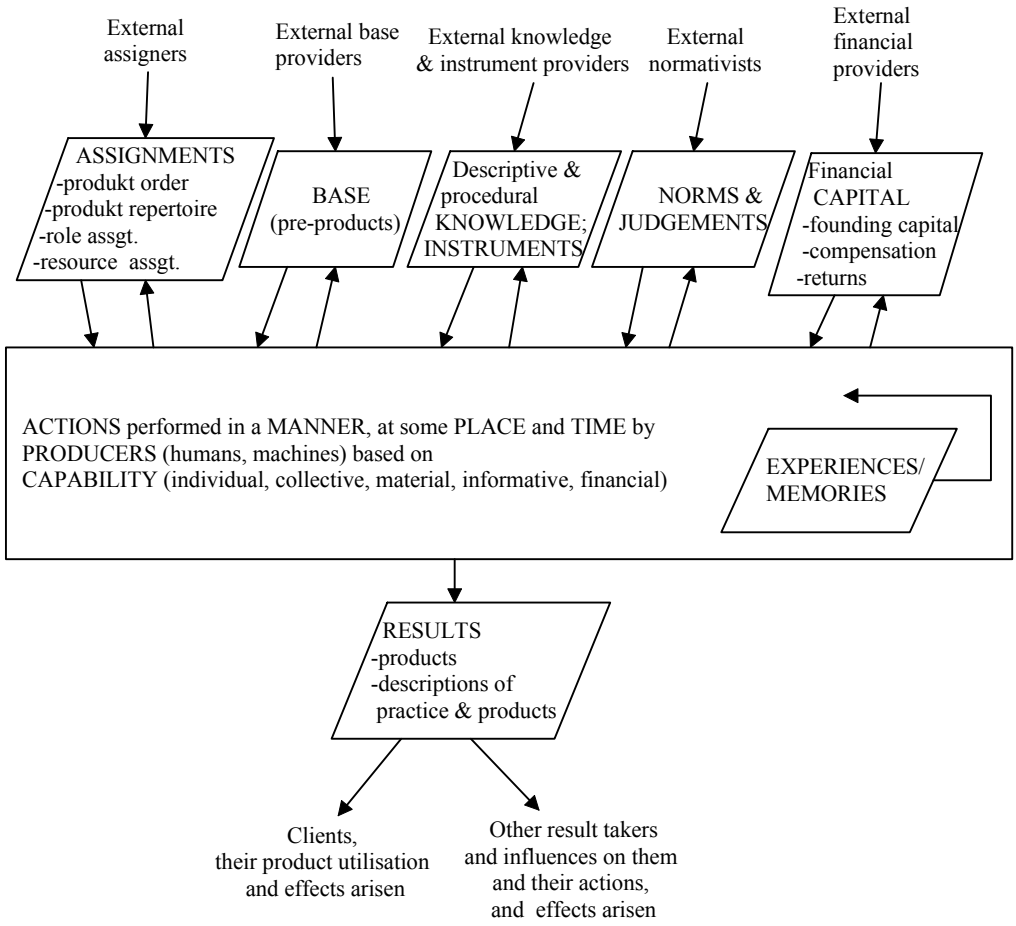

Figure. 3. The Theory-of-Practice Model

Producers are the actors who perform actions in order to create the results of the practice. The results are results of actions which imply that they are action objects. According to the definition, a work-practice consists of a set of actions where a producer produces something for a client. The main idea of a work-practice is to satisfy clients through the production of a result (product), which can be both commodities and services. The commodities or the result of services should also benefit some actors. These actors are called clients.

In order to produce results for the clients there has to be a number of prerequisites i.e.:
Assignments
Base
Financial capital
Norms and judgements
General and procedural knowledge and instruments.

These are general categories which can be used to analyse the functionalities (or roles) of action objects that are inputs to the work-practice.

3.3.1 Assignments

One or several assignments exist for each work-practice and the work-practices are based on assignments: product order, product repertoire, role and resource. The product order tells the producer what to do and initiate actions in the work-practice. The product repertoire specifies which products should be produced. The role assignment describes the roles of different

actors, what responsibilities the actors should have and defines what is expected of them. The resource assignment defines how the work-practice should be financed.

3.3.2 Base

An important prerequisite for the work-practice is the base. The base is objects which should be transformed into products, and therefore they are also called pre-products. The base can be raw material or information which can be further processed and transformed into a result.

3.3.3 Financial capital

This means founding capital and economic compensation.

3.3.4 Norms and judgements

Norms and judgements govern the actions performed in the work-practice and are used to evaluate the quality of the work-practice. Norms regulate the actions of the producers and the quality of the result, and as a consequence the work-practice is governed by norms. There are often quality norms that specify which qualities the products of the work-practice should have. There are also norms that tell the producers which types of actions they are permitted to perform or not.

Judgements are statements that concern the way the work-practice is performed. It can be statements that describe both positive and negative aspects of the work-practice.

3.3.5 External descriptive and procedural knowledge and instruments

Work-practices use different types of instruments and knowledge to perform the actions in the work-practice. The producers need to have both procedural and descriptive knowledge in order to perform their work. The actors also need other types of knowledge e.g. about norms and assignments. In order to act the producers have to have knowledge of different input and output action objects. This is called descriptive knowledge. The producers also need knowledge about how to perform their actions; this is called procedural knowledge.

Instruments are all kinds of tools and machines that support or mediate actions in the work-practice. Information systems are seen as instruments in work-practices. As an instrument, an IS assists producers to perform actions. Such instruments will also be artificial producers functioning as 'actants' and performers of actions (Goldkuhl & Ågerfalk, 2005).

3.4 The motives for choosing the Theory-of-Practice Model

The main reason for choosing the ToP-model is that the work-practice's use of standards has been under-studied (West, 2003). In paragraph 2.3 above we could see that the research on ICT-standardisation has been focused upon:

standardization as an innovation and product development process. This research stream is based on theories dealing with innovation and product development (Miller and Morris, 1999; Rothwell, 1994).

as a decision problem has mainly been focused on adoption decisions for standardized IT-products. This research stream has mainly been informed by economic theories (Arthur, 1989; Farell and Saloner, 1989).

as a socio-technical process has mainly been focused on standardisation as a form of social interaction, within a network of actors, and how the standards are introduced and stabilised in the network. This research is based on Actor Network Theory (Latour, 1993).

However these theories do not explain which functions standards can have for a work-practice when it is actually used, and how standards are made usable for work-practices. This opens up for theories such as the ToP-model to explore standards from a use and work-practice perspective. This is in line with the view of Aggarwal and Walden (2004) who claim that from a manufacturer's point-of-view ICT standards can be seen as inputs into the production of IT intensive products (ibid). This we agree on; however, to say that ICT-standards are inputs to the production of IT-products does not really give a thorough understanding of how they can be used, and which role they can have for work-practices.

3.5 The standards used in the RDS-TMC service

The RDS-TMC-service is an on-trip traffic information service for travellers and drivers communicated with the help of the RDS radio channel. RDS-TMC is an abbreviation for Radio Data System-Traffic Message Channel. The RDS-TMC service and the ALERT-C and Locaction Code standards which the service is based upon, supports a digital, silent broadcasting service for motorists, providing information about many kinds of traffic events. This includes roadworks, weather and traffic incident information to major national and international routes, regional routes and local or urban roads. The TMC messages are language-independent, and can be presented in the language of the user's choice. A typical message is showed in the figure below. The RDS-TMC messages are presented on special terminals (receivers) that are manufactured by a number of companies and installed in the vehicles (see the figure below).

Figure. 4. RDS-TMC Receivers

Most TMC products today are in-car GPS navigation systems, using TMC information delivered using the RDS Radio Data Service over the FM radio network. Systems typically also allow the driver to look at the traffic information received, either as icons on their navigation map or as a text description.

The RDS-TMC service is based on the ALERT-C and Location Code standards which specify how the traffic message should be coded and distributed to drivers and travellers.

3.5.1 The event list

An important part of the standard is the event list (ISO 14819-2:2003). The standard describes both the information structure and the content of the event list. This means that the events in the list are defined and approved by CEN, as a consequence all the events in the list are the same for all the countries in Europe. However the event list is translated into different national languages. In figure 5 below we can see how the event list and location code table (which is described in the next section) are used to translate the coded RDS-TMC message sent.

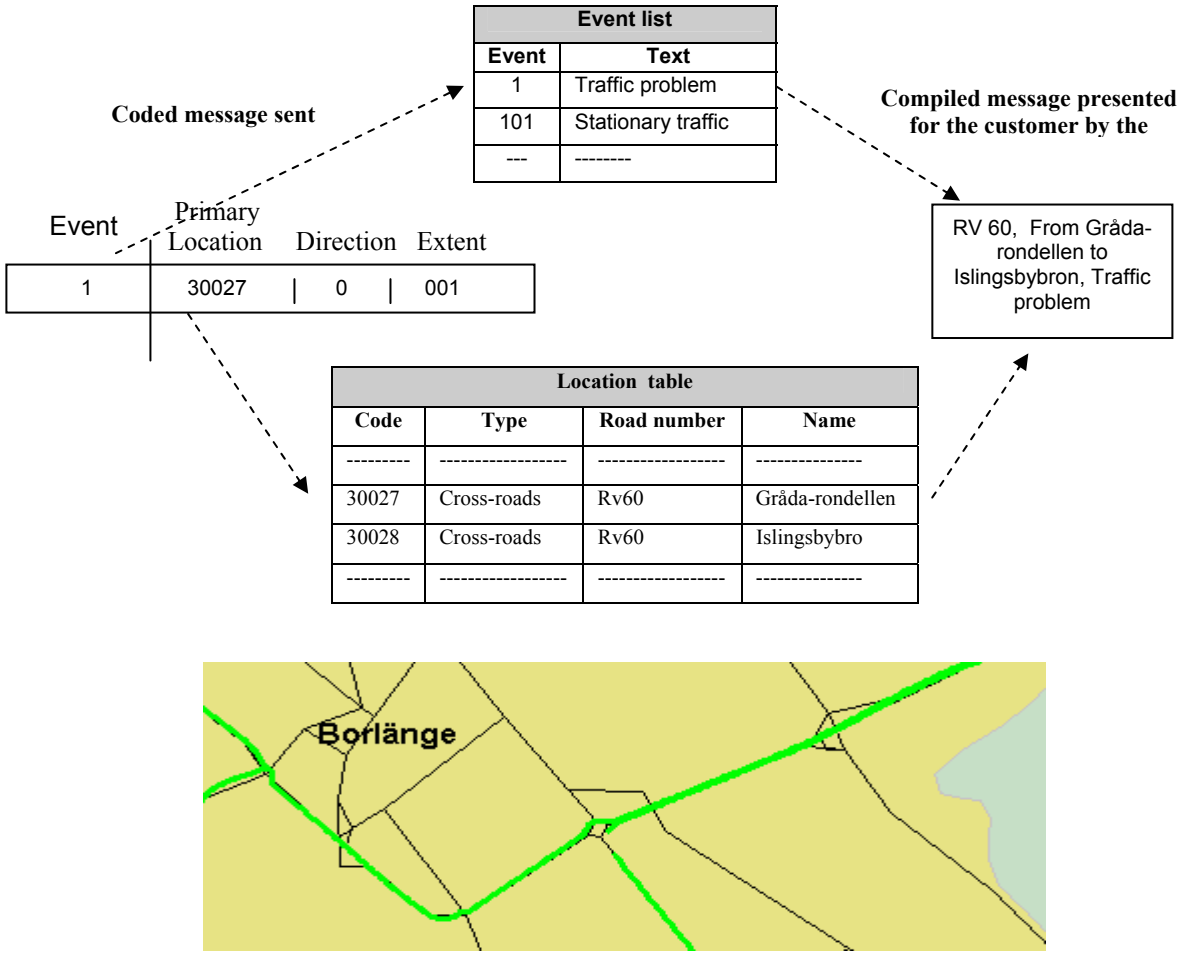

Figure. 5. The structure of a sent coded RDS-TMC message and how it is compiled

The coded message sent is described on the left of the figure. The event is a traffic problem (Event Code = 1). The primary location is Grådarondellen (Location Code = 30027). The extent of the event is to the next Location Code, 30028 (i.e. Islingsbybron) in the direction of the road. This is coded by the 0 in the direction field and the 001 in the extent field. This translation is performed in the receiver application which is installed in the vehicle which implies that both the event list and the location code table have to be installed in the receiver of the car.

3.5.2 Location code

Information about locations is a very important part of a traffic message, and the Location Code (Location Referencing Rules) is a European standard designed by CEN (ISO/TS 14819-

3:2000) to support the definition of locations used in traffic messages. The standard describes rules for how places, which are related to the road network, can be coded and named (ISO/TS 14819-3:2000). This is described by defining rules for location categories and the management of location tables.

3.5.3 TMC Forum

The TMC Forum is a non-profit association of key players within the field of TMC (TMC-Forum, 2006). The current members come from a variety of sectors, i.e. service providers, receiver manufacturers, car manufacturers, map database suppliers, public authorities, broadcasters and other organisations. The TMC Forum's mission is to be the focal point and authority for TMC across Europe, and to drive the market for TMC products and services forward. Consequently the TMC Forum provides support for the use of the ALERT-C and Location Code standards.

4 The work-practice of the RDS-TMC service production process

In this section the production of the RDS-TMC service in Sweden will be described with the help of the ToP model.

4.1 Product and client

The result of the RDS-TMC service is to provide drivers and travellers with dynamic information about congestions, accidents and road conditions in order to make better informed decisions during the trip. This means that the clients of the service are the travellers, i.e. the drivers or passengers of vehicles. The RDS-TMC service is also very often embedded in navigation systems providing additional services such as map based presentation of the messages, and dynamic navigation.

4.2 Producers and actions

The core production process is the production of the actual message. This is performed by the operators who are working at the Traffic Information Centres (TIC) organised by the SRA of Sweden. The actions they perform are to receive information that is reported to the TIC from emergency centres and the police. The operators also analyse information provided by cameras and sensors that are used to supervise the traffic situation. Based on this information RDS-TMC messages are coded and stored with the help of the TRISS-system (see below). These messages are then checked with the help of the TMC-editor application before they are broadcast (see below).

The producers in the core production process are:
The co-ordinators and the operators at the TIC.
The people at the SRA headquarters who are systems owners and system administrators of the systems used to produce the service (see below)
Terracom which operates the radio network.

4.3 Instruments

The most important instruments for providing the RDS-TMC service are the information systems used in the work-practice. How these systems are organised is described in the Information Systems Architecture (ISA) described below:

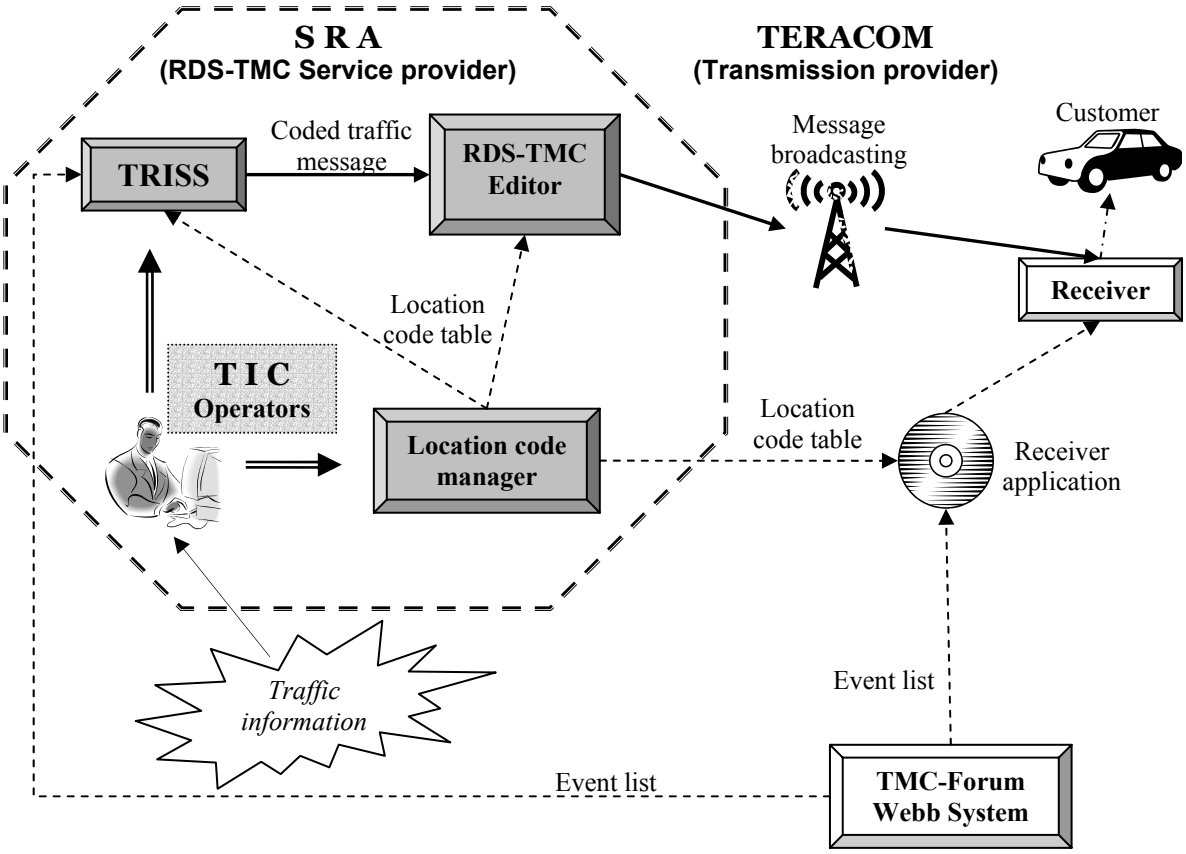

Figure 6. The systems which are used to provide the RDS-TMC service.

The main components of this ISA are the receiver application which is running at the RDS-TMC receiver in the vehicle; the TRISS-system and Location Code manager used at the TIC; the RDS-TMC editor used at the SRA headquarter; and, TMC-Forum's website.

TRISS is the system where the traffic information is stored at the SRA and it is the basic system for a number of traffic information services, one of them is the RDS-TMC service. The TRISS-system is used by the operators at the Traffic Information Centres in Sweden to create the RDS-TMC messages and a number of other traffic information services.

The Location Code Manager System is the application used to maintain the location code database. The system is used by the operators at the Traffic Information Centres who use the system to create, code and name locations which are stored in the location code database.

The RDS-TMC Editor is a system used to decide which RDS-TMC messages should be transmitted to the clients. The coded RDS-TMC messages are imported from the TRISS system. The RDS-TMC Editor quality controls the imported messages.

TMC Forum has a website from where the different national event lists can be retrieved.

The application used in the RDS-TMC receivers is developed by a number of system vendors who deliver the RDS-TMC receivers and associated software and information. The receiver application is used by the clients to receive the RDS-TMC messages, before they are transmitted.

The standards ALERT-C and Location Code described in the previous section have been implemented in this ISA. This implies that the system developers have used these standards when they developed the systems, the databases and the information exchange between these systems. This ISA is a fundamental instrument of the RDS-TMC production process. Presently the system administrators use the standards when they are maintaining the ISA. The fact that the standards are implemented in the systems implies that the standards are used when the systems are used and information is exchanged when the RDS-TMC service is provided. This implies that the standards can be considered as instruments for the work-practice. The standards are used as instruments in two ways:
1. Through the IS because the rules and specifications in the standards have been implemented as functionality, type messages and databases in the ISA described above.
2. Through the standard documents which specify the rules for how the content of the location database should be created and maintained and how the actual messages should be created and coded.

4.4 External descriptive and procedural knowledge

The fact that the standards both describe what and how the result should be produced implies that the standards contain external descriptive and procedural knowledge that is important for the work-practice. The event list represents descriptive knowledge for the operators at the TIC. The rules that specify how location codes and the actual RDS-TMC message should be coded are an example of procedural knowledge. The fact that the IS-architecture is the most important instrument in the work-practice and that many of the rules have been implemented in the systems, implies that knowledge about these systems, and how to use these systems, is procedural knowledge for the operators and the work-practice.

4.5 Assignments

The product assignment is to produce the standard product, i.e. the RDS-TMC message, described in the standards documents. These documents describe the service on a type level; this is called the product repertoire in the ToP-model. This implies that the standards are an important part of the product assignment for the practice because they describe the product that should be produced, and the assigner is the SDO which has produced the standards. At the national level the product assigner is the SRA headquarters who is an agent for the government which in turn is the actor who has decided that this service should be provided in Sweden. The product order which is the product assignment at the instance level is carried out by the drivers and travellers who have bought and installed the necessary equipment in their vehicles to receive the messages. This means that they are product assigners at the instance level.

4.6 The base

The base for the work-practice is the information that is reported by Emergency Service Centres, the Police and other actors to the TIC, as well as the information that is retrieved by cameras and sensors. This base information is stored and processed by the operators with the help of the TRISS-system producing RDS-TMC messages and other types of traffic information messages.

4.7 Norms

The norms of the work-practice define what can or cannot be communicated in the produced RDS-TMC messages. This implies that the ALERT-C and Location Code standards are norms for the activities and the results produced in the service production process. One example is the event list which defines what type of traffic events can be communicated by the operators in a RDS-TMC message. Another example is the rules that prescribe how information should

be created in the location database. This also implies that the quality of the produced messages can be evaluated in relation to the rules described in the standards. For example the RDS-TMC editor system controls the quality of the messages created at the TIC before they are transmitted. This is done by checking the messages so that they comply with the rules and specifications in the standards. However the quality of the messages cannot only be evaluated in relation to the norms in the standard. The quality of the messages should also be related to other norms (criteria), e.g. if the information is useful for avoiding traffic congestions and queues.

5 Evaluation of the standards

From the analyses made in section 5 we conclude that the ALERT-C and Location Code standards can be described as instruments, external descriptive and procedural knowledge, norms and as a part of the assignment for the RDS-TMC production process. In this section the standards will be evaluated based on these categories.

5.1 The standards as instruments

Instruments are tools which should support actions in order to achieve goals and results in an efficient way.

A basic goal with ICT-standards is that they should be an instrument for inter-operability between IS, organisations and humans. If we evaluate the ALERT-C and Location Code standards as instruments for producing the RDS-TMC service we can say that they fulfil this function. This means that standards have made it possible to implement the ISA described above, i.e. they are effective instruments that support the inter-operability in the RDS-TMC service production process.

Another important reason for the success of the standards is that they are not only the instruments for the RDS-TMC service; they are also the means for in-car GPS navigation systems, enabling dynamic route guiding.

One important goal with the RDS-TMC service is that it should be language independent, and the existence of the pre-defined event list specified in the standard is a prerequisite for this. This means that the standardised event list is an important instrument for achieving this goal. However, the event list is not a perfect instrument; according to the TIC-operators a number of problems concerning the use of the event list affect the quality of the service, and there are also problems using the Location Code standard see below.

5.2 The standards as norms

Norms tell the actors what they can or cannot do. Norms are also used to evaluate the quality of actions, results and effects.

The standards are strong norms for the actions performed in the production of the RDS-TMC service. For example, the event list specifies in detail which traffic events can or cannot be communicated. This means that the TIC-operators have to match actual traffic events with the event list and choose the event with the best match. The TIC-operators have a pop-up list containing events which are of current interest for use. One problem is if the traffic event is not a part of the pop list, the TIC-operators then have to search through the whole event list, and this is difficult.

Another problem with the event list is that it is too general which implies that it is hard to adjust it to the specific needs of a single country. For example some of the traffic events that are related to the winter road conditions of Sweden are not a part of the event list.

The Location Code standard specifies how location codes should be created and used. This can have both a good and bad impact on the quality of the service. The people at the TIC claim that it is complicated and hard to understand how to use the location codes. The TIC-operators do not think that it is satisfactory to use location codes to describe places for traffic messages. It is easier to describe places for traffic messages with the help of free text. Location codes are generally only located at crossroads which means that in some cases there can be up to 120 km between two location codes. In this situation if the traffic event arises between these location codes it is hard to give a more precise description for the place of the traffic event.

On the other hand there are arguments put forward by the people at the SRA headquarters that the standards improve the quality of the service. They claim that explicit and formalised rules for Location referencing, make it possible to evaluate the location descriptions in the messages.

5.3 The standards as external descriptive and procedural knowledge

The Alert-C and Location Code standards contain external knowledge that describe what should be produced and how. According to the ToP-model external knowledge, if it is to fulfil its function, must be internalised into a capacity to act.

The problems described in section 5.2 above show that the TIC-operators have problems using the standards, and these problems of interpreting the norms and rules of the standards are not unique to Sweden. The standards have to be explained in more detail in order to be understood by the service providers. This is the reason why a lot of documentation has been produced in order to explain the standards. In the document ALERT-C Coding Handbook it says (TMC, 99a):

> ”*Coding protocol for the Radio Data Systems Traffic Channel (RDS-TMC) is the standard that defines the ALERT-C coding of traffic messages. As with all standards, it contains only the bare facts, only a few explanations and even less justification. Consequently, it gives little help in understanding the rules that are given and no help in understanding why the rules are given as they are. The Alert-C handbook aims to fulfil these gaps*”.

The TMC-forum has also produced a document, ”Location Coding Handbook”, to give more guidelines on how to interpret the Location Code standard. In this document it says (TMC, 99e):

> ”*As experienced by countries that have already created their location databases, a further specification within the general framework of the standards is necessary. For this purpose the Location Coding Handbook has been developed*”.

We can see that a considerable effort has been made by the TMC Forum to develop handbooks (TMC, 99a-e) that support the use of the standards, and this has been a key factor in the process of internalising the standard in the work-practices which use the standards across Europe.

5.4 The standards as assignments

The standards can be seen as a global product assignment for the work-practices that intend to implement the RDS-TMC service. It is important to recognise this because this is one of the major reasons why it has been possible to realise the service worldwide. The global product assignment is the key factor that has motivated manufacturers to invest money in the development of the receiver and receiver applications. The global product assignment gives manufacturers the reassurance that their receivers will be able to receive the messages no matter who the service provider is, or where in the world the messages are communicated.

6 Conclusions

If we try to answer the basic research question i.e. which functionality (role) conceptual standards can have for the work-practices that produce e-services, and what makes them usable. We can describe this with the ToP model and figure 7 below:

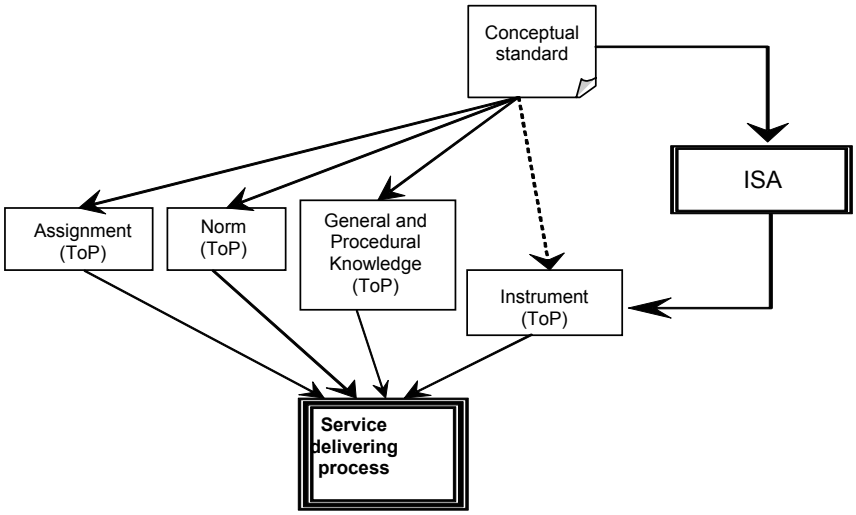

Figure 7. Conceptual standards and their functions for the e-service production process.

The figure above shows how conceptual standards are important prerequisites for the work-practice and that they can fulfil the following generic functions for the work-practice. They can have the role of being:

- instruments for the work-practice;
- norms that describe how things can be done and what can be done;
- external descriptive and procedural knowledge;
- a product assignment.

Standards have the role of being an instrument for achieving inter-operability between IS and organisations and this is the main motive for many standardisation efforts in the ICT-field. Surprisingly this important function has only been of interest in a nominal sense in the research in the IS-field (West, 2003). West (2003) claims that this is related to what Orlikowski and Iacono (2001) have bemoaned the lack of technology in IS research. From the analyses performed with the ToP-model we can see that the IS-architecture is the most important instrument for this work-practice and that the rules and specifications described in the standards are transformed, into functionality, type messages and databases in this IS-architecture. The standards are used as instruments in two ways:

1. Through the IS because the rules and specifications in the standards are implemented as functionality, type messages and databases in the ISA.

2. Through standard documents or documents that support the use of the standards which specify the rules for how the systems should be used.

This also means that the standards are norms for the work-practice governing what can be done and how it should be done. This also means that the standards have a strong impact of the usability or rather the actability of the IT-systems, because the standards prescribe a desired behaviour and are a norm for the actions performed through the system, and the quality of the service. The standards also represent descriptive and procedural knowledge which have to be internalized in the work-practice, and standards have the function of a product assignment.

What we can learn from the case-study is that it is important that conceptual standards fulfil these functions but that it also takes a lot of effort to make this happen. For example, one of the success factors is the fact that the implementation of the standards have been backed up by a support organisation the TMC-Forum. The TMC-Forum support the users of the standards, i.e. both the system developers who develop the IT-systems, and the users of the systems (the TIC-operators, in Sweden). This is done by explaining how the standards should be used, but also by changing the standards based on suggestions and complaints that they get from the users of the standards. Another success factor has been that the standards in this case have had the function of a global product assignment. This is important because it has made it possible for manufacturers to invest in the development of receivers and receiver applications.

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