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Intelligent transport systems — System architecture, taxonomy and terminology — Procedures for developing ITS deployment plans utilizing ITS system architecture

Systèmes intelligents de transport — Architecture, taxinomie et terminologie des systèmes — Procédures pour développer des plans de déploiement ITS en utilisant une architecture ITS

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 24098 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Introduction

This Technical Report was developed by ISO/TC 204, WG 1, *Architecture*, in order to provide a procedure for developing Intelligent Transport System (ITS) deployment plans utilizing ITS system architectures.

It is well perceived in the ITS community that understanding the system architecture is significant for the realization of ITS, which extends over wide areas on service domains, system sizes, and relating stakeholders and users. Those who deploy ITS systems within a specific region need to consider the coverage area, as well as existing inventories.

This Technical Report facilitates the introduction of ITS at regional levels through the development of the ITS deployment plans by utilizing regional ITS architectures.

Examples of ITS deployment guidelines are given in Annex A.

Intelligent transport systems — System architecture, taxonomy and terminology — Procedures for developing ITS deployment plans utilizing ITS system architecture

1 Scope

This Technical Report describes the procedure for developing Intelligent Transport System (ITS) deployment plans utilizing ITS system architectures. The document consists of the basic policy of ITS deployment and the procedure for developing ITS deployment plans. Framework, procedures and requirements for developing regional ITS deployment plans utilizing regional ITS architecture are reported.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14813-1:2007, *Intelligent transport systems — Reference model architecture(s) for the ITS sector — Part 1: ITS service domains, service groups and services*

ISO/TR 14813-5:1999, *Transport information and control systems — Reference model architecture(s) for the TICS sector — Part 5: Requirements for architecture description in TICS standards*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
institutional architecture
architecture based on political or administrational infrastructure partitioning and its division of responsibilities (rather than functions)

[ISO 14813-5:1999]

3.2
ITS service
consists of a product or activity targeted to a specific type of ITS user

NOTE 1 Adapted from ISO 14813-1:2007.

NOTE 2 An ITS service group consists of one or more similar or complementary services provided to ITS users. An "ITS service domain" refers to a specific application area which comprises one or more service groups.

3.3
ITS stakeholders
people or organizations that are involved in some way in the deployment of ITS

NOTE Their involvement can be through use, manufacture of products, provision of services, or regulations.

3.4
ITS user
one who directly receives and can act on ITS data, information or outputs that implement a measure of control

NOTE 1 Adapted from ISO 14813-1:2007.

NOTE 2 An ITS user is one who receives, directly or indirectly, or provides, the transaction of an ITS service. These users of ITS services may be human, systems or environment monitoring.

3.5
logical architecture
functional architecture
functional viewpoint
describes how the system behaves, including what it does with the inputs that it receives and how it produces the outputs; it may be described either from an object-oriented, or process-oriented, perspective and describes the system according to its behaviour

NOTE 1 Adapted from ISO 14813-1:2007.

NOTE 2 In an object-oriented perspective, a logical architecture elaborates the conceptual behaviour and in so doing defines some detail of the objects. In a process-oriented perspective, the logical (or functional) architecture determines the nature of the system (in terms of functions and data stores), and describes its conceptual behaviour and the detail of what must be done to the inputs to produce the outputs. The logical architecture is independent of any hardware or software approach.

3.6
physical architecture
allocation of the logical architecture to physical entities but not including details of the deployment of specific numbers of systems or equipment at particular geographic locations

NOTE 1 Adapted from ISO 14813-1:2007.

NOTE 2 A physical architecture, whilst describing physical configurations in system terms, is not specific to any particular location.

3.7
physical model
subset of a physical architecture which mainly considers the realization of providing one or more service(s)

4 Abbreviation

For the purposes of this document, the following abbreviation applies.

ITS Intelligent Transport System

5 Basic policy of ITS deployment

5.1 Realization of regional ITS

The general framework of ITS deployment within a region (or any other part of a nation, such as a city, state, or county) is described in Figure 1. The target is realization of regional ITS systems and provision of ITS services to the users by the collaboration of subsystems that are implemented by relevant ITS stakeholders.

An ITS deployment plan for a region will make the efficient implementation through the intelligible accountability and the consensus among the regional stakeholders. The plan is used for obtaining a budget for deployment, for designing the regional ITS systems, and for promoting the deployment and operation of the systems within the region.

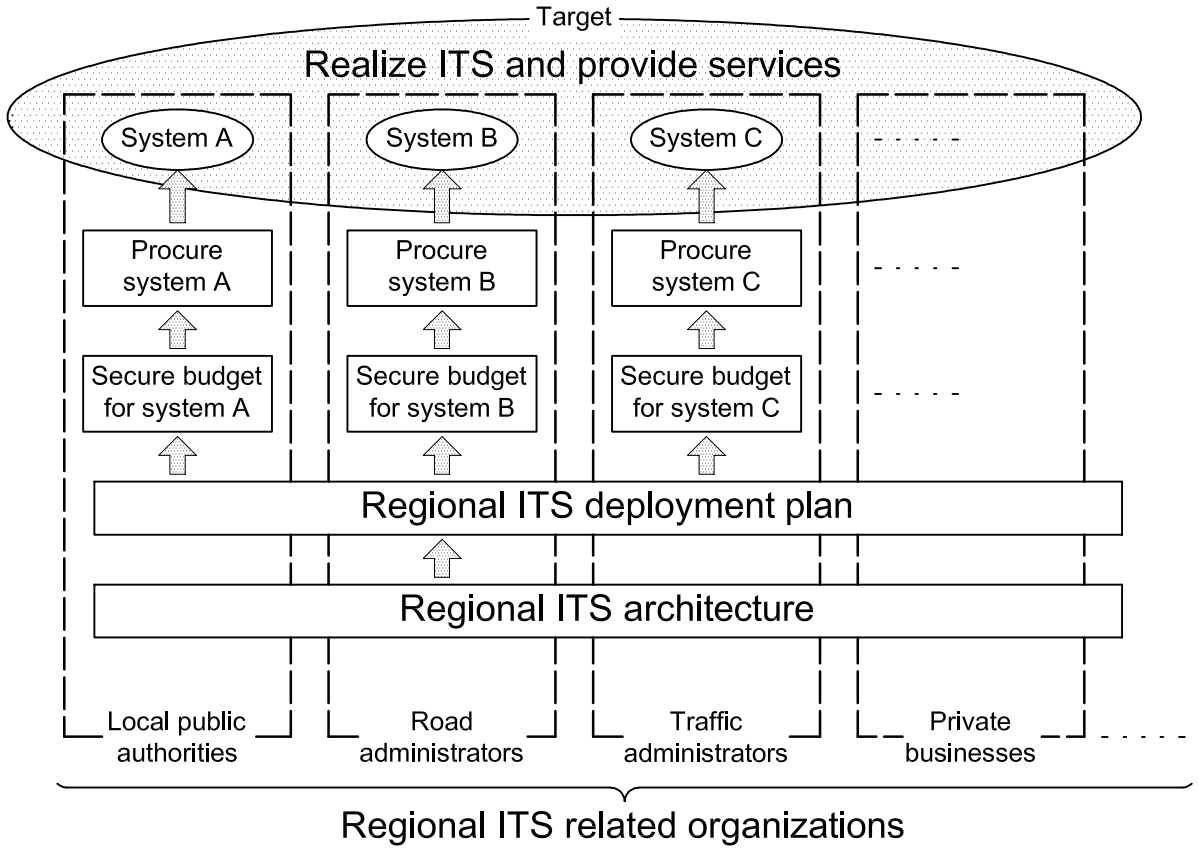

Figure 1 — Framework of regional ITS deployment

5.2 National ITS architecture

There are several ways in which a national ITS architecture can be used to create ITS deployment plans. These are illustrated in Figure 2.

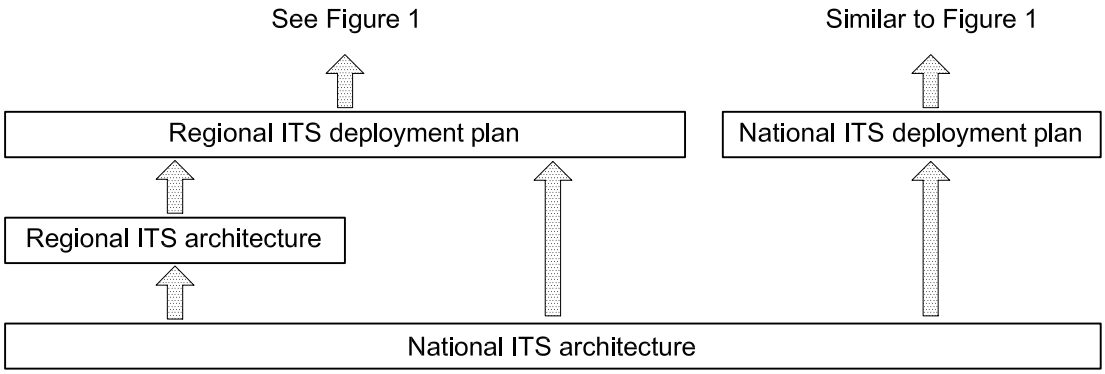

Figure 2 — Relationship between regional and national ITS deployments

The example in Figure 2 enables interoperability between the ITS systems deployed at nearby regions, as well as within the target region itself.

6 The procedure for developing ITS deployment plans

6.1 Framework

A national architecture covers overall ITS services within a nation and this may be what is needed for some ITS deployments. However, a regional architecture may be needed when only some of the ITS services within the national architecture are required.

In order to realize sustainable ITS within a region or nation, it is necessary to identify the ITS services that are required, to establish subsystems by dividing roles among ITS-related stakeholders, and to keep a close liaison between those stakeholders.

To achieve this, it is necessary to prepare ITS deployment plans based on the regional or national ITS architecture. These plans will illustrate the division of roles and coordination between ITS stakeholders. Based on these plans, it will be possible to negotiate and secure budgets and establish operational systems at the stakeholder level.

6.2 Procedure

The procedure for developing an ITS deployment plan for a region or nation should be the following.

— Identify the appropriate ITS stakeholders and gain their cooperation and participation.

— With the stakeholders, define the ITS services that they want to see deployed.

— Describe the ITS physical system structure that is needed to provide the services.

— Define and agree upon the stakeholders' roles for the ITS deployment.

6.2.1 Identifying the participation of appropriate ITS stakeholders

It is essential that the scope of the regional (or national) ITS architecture, and the identification and participation of the ITS stakeholders involved in the development process, are determined and agreed.

The mobility of residents in daily activities should be taken into account (e.g. commuting, shopping and business). The geographic coverage of the ITS architecture will depend on the area of jurisdiction belonging to its owners. Thus, regional ITS architecture may cover one or more metropolitan regions and transport infrastructures between them, and a city ITS architecture may cover one city. The area where the stakeholders involved in the ITS development operate or administer should also be taken into consideration. However, the need for a regional ITS architecture should also depend on how much of the national ITS architecture it will include.

Stakeholders involved in the development of the ITS architecture should include organizations that fit into one or more of the following types. These types should include those stakeholders that:

— want ITS: these will be local authorities that manage the highways, and road operators that will want ITS to improve the operation of their transport networks;

— make ITS: these will be organizations that are component and system suppliers and/or infrastructure providers that will see ITS as providing them with extra business opportunities;

— use ITS: these will be travellers, pedestrians, PT passengers, plus those that move freight; all of whom hope that ITS will improve the ways that they can travel;

— rule ITS: these will be organizations such as national and regional governments and standards bodies that regulate and control the way that ITS is deployed and implemented.

A broad range of stakeholders of several of the above types may exist within the area in which ITS is to be deployed. It is also important for any stakeholders whose existence is recognized during the ITS architecture development process be asked to participate, as appropriate.

It is important to ensure that outreach to the ITS stakeholders gains commitment to the usefulness and significance of the ITS architecture in the process of establishing the ITS systems that need to be deployed to provide the services.

It is useful to nominate a leading stakeholder, sometimes called the “architecture champion” to urge all the stakeholders to participate positively in the establishment of the ITS systems. The leading stakeholder will normally review the area covered by the ITS architecture to be developed and identify the stakeholders participating in the development process.

6.2.2 Defining ITS services

Services to be provided within the area of the ITS deployment should be based on local issues and needs for transportation. The services that are required are normally selected from the list of ITS services described in the national ITS architecture or the framework ITS architectures that are to be adopted. Consideration must be allowed for the services currently existing in the region to be incorporated into the ITS architecture and the resulting ITS deployment.

Issues arising in the area of the ITS deployment and the needs of users and stakeholders are compiled and categorized by causal factors from the perspective of each stakeholder, in order to gain an understanding of the issues and needs of the transport area.

The issues and needs thus identified are used in a subsequent process for selecting the ITS services that resolve the issues and the needs. This process identifies all the ITS services to be realized within the area.

6.2.3 Describing the ITS physical system structure

According to the ITS services selected for the region, the ITS physical system structure within the deployment area is envisioned and then elaborated. National ITS architectures may be used or referenced to develop the ITS physical models. These physical models are designed to meet the ITS deployment needs as building blocks for the ITS architecture.

The physical system structure may be developed either directly, or by the modification of the individual physical models described in the national ITS architecture. Specifically, new individual physical models are produced by adding or deleting individual physical model subsystem(s), and/or revising definitions to correspond with the content of services within the area of ITS deployment. A new subsystem definition may be created if a particular functionality is not already in the national ITS architecture

This enables the establishment of a comprehensive ITS system model structure and the documentation needed to complete the ITS architecture.

6.2.4 Deciding the stakeholders' roles for the ITS system deployment

Based on the ITS physical architecture that has been developed, and combined with the physical models of the area of ITS deployment, stakeholders should be assigned as cooperating partners.

The ITS architecture is completed by checking the future plans for the area and the envisioned ITS requirements based on the services to be introduced. The allocation of responsibility for the deployment and operation to each subsystem should be agreed by the stakeholders. All stakeholders involved should confirm agreement to the completed ITS structure.

The structure of the ITS systems illustrates the relationships between each stakeholder. The structure may be developed into an ITS institutional architecture within the area. It provides an overview of the ITS systems to be deployed and operated within the area.

6.3 Requirements

6.3.1 Contents

The ITS deployment plan should be formulated, based on the ITS architecture, by completing all documentation and sharing information with every stakeholder. The ITS architecture illustrates information to be exchanged, as well as functions (subsystems) installed by each stakeholder. This helps organize the liaison between stakeholders and helps to coordinate information exchanges.

The ITS deployment plan should include the following contents:

— ITS stakeholders;

— ITS services;

— ITS system structures;

— stakeholders' shared roles.

6.3.2 Documentation

The ITS deployment plan should be documented and subsequently facilitates the coordinated deployment of ITS systems by stakeholders within the area.

The deployment plan should make reference to the system concept diagrams that illustrate specific equipments or systems of the ITS plan that have been included in the physical and communications architectures. Some supporting diagrams and tables are prepared to identify the amount of systems and equipment required, based on the area-wide and the organization-specific system structures and on the characteristics of the transport network that is covered by the ITS architecture.

The deployment plan coordinates the use of data attributes, such as name, size, frequency of exchange, and format of data, and system connectivity between subsystems implemented by stakeholders.

The ITS deployment plan should include specific schedules based on actual geographical conditions and on financial constraints. Formulating the deployment plan clarifies the equipment required for the ITS system(s), which serve to quantify and establish an annual deployment plan and budget for the region. The annual plan helps to aggregate basic material requirements, in order to support budget requests by the stakeholders in an efficient manner. Consideration must also be taken of any exiting (legacy) equipment or systems, and whether they need to be modified or replaced.

Annex A
(informative)

Examples of ITS deployment guidelines

A.1 Guideline for the regional ITS deployment plans (ITS Japan)

This clause was prepared by ITS Japan. It is a guideline for stakeholders on regional ITS. The guideline describes a procedure for creating a regional ITS architecture and a conforming regional ITS implementation plan.

The procedure for developing regional architecture consists of five steps from step 0 (preliminary process) to step 4 (utilization and maintenance).

Step 0: “Preliminary process” instructs the importance for the regional stakeholders to work together on the process for developing regional architecture. The purpose of this process is to ensure that the regional stakeholders are aware of the need for regional architecture in realizing regional ITS, obtaining interoperability, and re-use of data. Three main components of the preliminary process are described as

a) defining the region covered and stakeholders involved,

b) publicizing the purpose and benefits of regional ITS architecture and the national ITS architecture, and

c) formulating a regional architecture development plan.

Step 1: “Selecting services to be provided in the region” requires the identification of problems and needs associated with road transport in the region and relevant systems currently in operation in the region, in order to clarify the image of the ITS service(s) suitable for the region. The process to identify all ITS services to be provided in the region is summarized as threefold:

a) understanding transport problems and needs in the region,

b) understanding existing systems in the region, and

c) selecting sub-services to be provided.

Step 2: “Producing physical models” defines the structure of the system for providing ITS services in the form of physical models. The process consists of the following components:

a) revising individual physical models,

b) deciding which entity is responsible for providing each sub-service, and

c) final confirmation of functions (subsystems) to be provided by each stakeholder.

Step 3: “Completing the regional architecture” develops a system model diagram for the whole region based on the roles and functions of each stakeholder, decided by a consensus building process. The process is characterized by two components:

a) checking the verity and validity of model diagrams, and

b) full documentation of the regional ITS architecture.

Step 4: “Utilization and maintenance” is prepared for usage of the regional ITS architecture. A deployment plan is formulated according to the regional architecture. Review and maintenance of regional architecture is also recommended. Two components are depicted to characterize the regional architecture:

a) deployment of ITS by utilizing regional architecture, and

b) review and maintenance of regional architecture.

The ITS Japan document which this section summarizes, further includes the procedures for developing an ITS implementation plan that utilizes regional architecture. The utilization of an ITS implementation plan is explained by:

1) creation of basic reference material for budget planning,

2) correlation between participating stakeholders, and

3) study of ordering specifications.

A.2 Regional ITS architecture guidance (US Department of Transportation)

This document was prepared by the US Department of Transportation. It is a guide for transportation professionals who are involved in the development, use or maintenance of regional ITS architectures. The guidance describes a process for creating a regional ITS architecture with supporting examples of each architecture product. In its discussion of the uses of the regional ITS architecture, the document presents an approach for mainstreaming ITS into the transportation planning and project development processes.

The regional ITS architecture development process is structured by six steps. The first step is named “Get Started” and recommends a focus on the institutions and people involved. The relevant stakeholders involved in architecture development are organized as a team. One or more leading stakeholders are identified and called “champions”.

The second step is “Gather Data”. Once the stakeholders are involved, the focus then shifts to the ITS systems in the region. The existing and planned ITS systems in the region are inventoried, the roles and responsibilities of each stakeholder in developing, operating and maintaining these ITS systems are defined, the ITS services that should be provided in the region are identified, and the functionality that each system will make to provide these ITS services is documented.

The third step is “Define Interfaces”. After the ITS systems in the region are identified and functionally defined, the existing and planned interfaces between these systems are defined. The connections between systems are identified and then the information that will be exchanged on each of the interfaces is defined.

The fourth step is “Implementation”. Additional products can be defined that will guide implementation of the projects that will flow from the regional ITS architecture. A sequence of projects, a list of needed agency agreements and a list of standards that can be considered for project implementation are provided.

The fifth step is “Use the Regional ITS Architecture”. The regional ITS architecture is an important tool for use in transportation planning and project implementation. It can identify opportunities for making ITS investments in a more cost-effective fashion. This step is where the benefits are realized.

The final step, “Maintain the Regional ITS Architecture” is also presented. As ITS projects are implemented, new ITS priorities and strategies emerge through the transportation planning process, and the scope of ITS expands and evolves to incorporate new ideas; the regional ITS architecture will need to be updated. A maintenance plan is used to guide controlled updates to the regional ITS architecture baseline so that it continues to accurately reflect the region’s existing ITS capabilities and future plans.

A.3 Deployment guidance for Europe

The deployment guidance for Europe is based on that which has been promoted by the European-Commission-funded KAREN and FRAME Projects. It is based on the use of the European ITS Framework Architecture, which provides the starting point for ITS architecture development at national and regional levels.

The way in which the European ITS Framework Architecture is used for ITS deployment is illustrated by the diagram in Figure A.1.

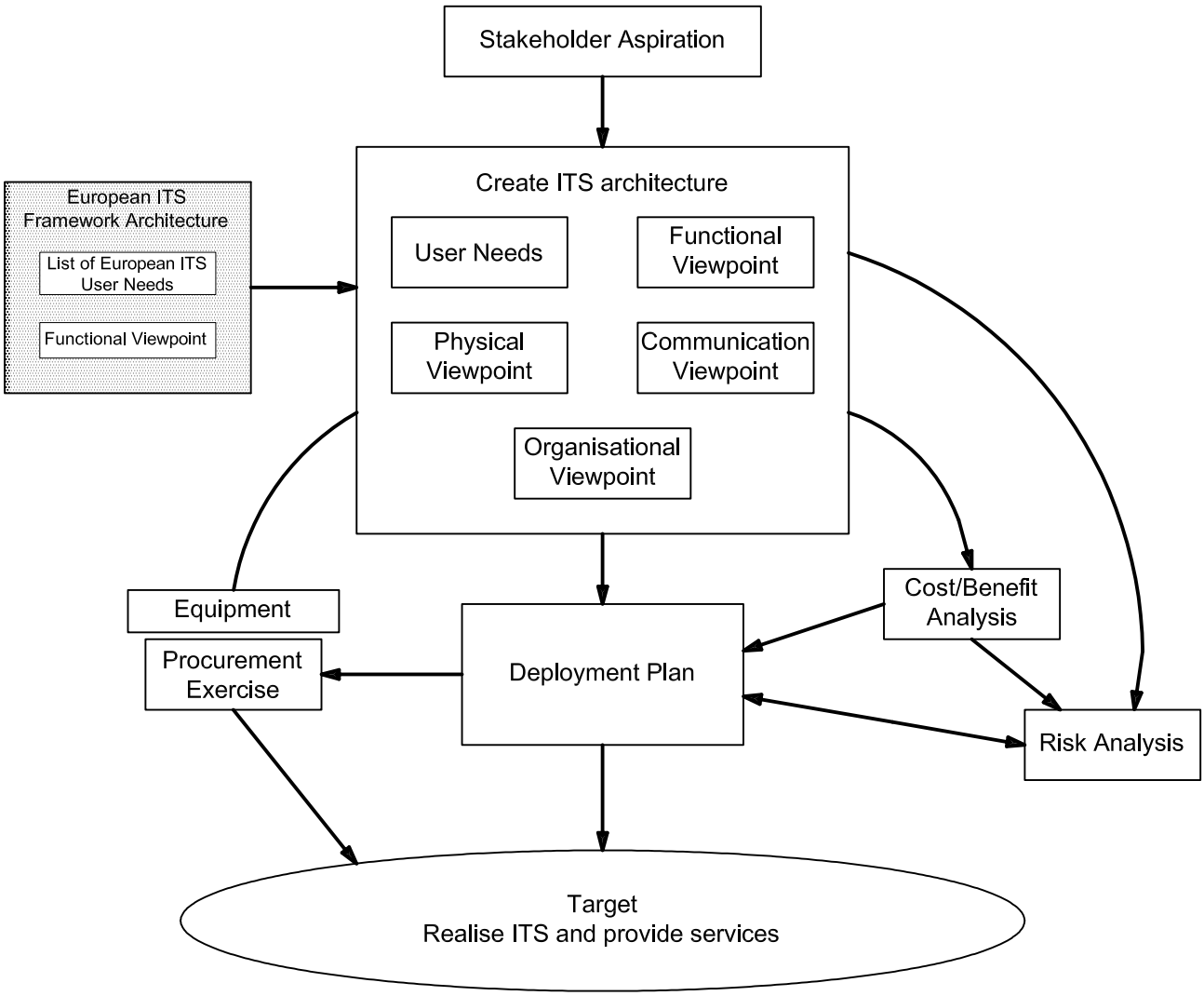

Figure A.1 — Use of the European ITS Framework Architecture in ITS deployment

The starting point is the stakeholder aspirations, from which the ITS architecture needed to support their realisation is produced, using the European ITS framework architecture as a starting point.

Once the ITS architecture has been produced, the cost/benefit analysis can be carried out and the findings are an input to the process of creating the deployment plan, as it enables the spending profile to be produced, which can then be matched to the forecast budgets. In parallel with the creation of the deployment plan, a risk analysis can be carried out which may in turn directly influence the contents of the plan, but may also impact the architecture itself.

The deployment plan shows how the ITS will be realised by guiding the equipment procurement exercise, and hence provide the services that the stakeholders described in their aspirations. Note that many of the feedback paths and the involvement of the stakeholders in the processes leading to the realisation of the

services have been omitted for clarity. However, it is advisable to involve stakeholders at significant points in the process, e.g. getting approval for the physical viewpoint, the deployment plan, understanding the results of the cost/benefit analysis, etc.

A more detailed description of this process is in the electronic version of the FRAME workshop materials, available from the FRAME Web Site at: http://www.frame-online.net/training.htm.

A.4 ITS Toolkit for road transport in countries with developing and transitional economies (World Bank)

This document is prepared by the World Bank to provide guidance for countries with developing and transitional economies on strategies for introducing ITS, to help meet the challenges of surface transportation. The document observes ITS as the application of information technologies and most ITS applications have arisen in developed countries. However, a fundamental premise is that many ITS applications are equally applicable in countries with developing and transitional economies.

There are some ways in which countries with developing and transitional economies can more easily introduce and benefit from ITS than developed countries, by introducing ITS at the same time that other transportation infrastructure is being installed. The guidance provided by the “ITS Toolkit” is aimed primarily at policy and decision makers in the countries with developing and transitional economies. It strives to provide the background, context and tools for effective ITS planning and decision making. It provides a variety of examples of the introduction and use of ITS in a wide range of countries to help decision makers understand and select appropriate ITS applications for their particular circumstances. It addresses social, institutional and legal issues, as well as technology.

In Part 2 (Chapters 4-9) of the ITS Toolkit, the steps to ITS deployment are illustrated. Chapter 4 provides a catalogue of ITS applications that will be applicable in various countries with developing and transitional economies. It then provides tools that a particular country can use to evaluate the applicability of particular applications in its own economic and social circumstances.

Chapter 5 discusses the importance of creating plans for the development, introduction, operation, and maintenance of ITS applications, and provides detailed guidance on how to create these plans. It also discusses the important role of evaluation in all parts of the life cycle of ITS applications and how various kinds of evaluations should be carried out.

Chapter 6 discusses the issues of compatibility, expandability, interoperability and integration, and their importance to the management and expansion of ITS. The chapter emphasizes the importance of standardization and integration in keeping ITS applications current and helping them to grow successfully in correspondence with increasing demand. This includes standardized approaches to data models and communications. The chapter recommends the development of an ITS system architecture as an effective mechanism to cope with complexity and to assure that services are provided in a consistent and well-organized manner.

Chapter 7 discusses a variety of strategies for organizing and funding ITS projects, including strategies for appropriate public sector-driven projects, private sector-driven projects and joint projects undertaken by public-private partnerships.

Chapter 8 recognizes that ITS projects are social projects as well as technical projects, potentially with wide ranging impacts. In particular, this chapter explores legal issues that need to be addressed in introducing ITS applications, including enforcement, privacy issues, etc. It also describes the kinds of cooperation that is required between government agencies of various kinds, between these agencies and the private sector, and across national boundaries.

Chapter 9 discusses strategies and issues for properly operating ITS applications after their introduction and ways of keeping them up to date. These strategies mainly relate to the training and management of staff so that they are well prepared to operate and maintain ITS applications.

There are also a series of five technical notes and accompanying appendix that are available. These are extracted materials from the ITS Toolkit. The document titles of the five technical notes and the appendix are as following:

— Technical note 1: ITS for developing countries;

— Technical note 2: Two stage selection model for ITS applications;

— Technical note 3: Innovative approaches to the application of ITS in developing countries;

— Technical note 4: ITS standards for developing countries;

— Technical note 5: ITS system architectures for developing countries;

— Appendix: ITS applications around the world.

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[3] KAREN, *Deployment Approach and Scenarios*, EC FPIV project KAREN (TR4108), Deliverable No. D4.1, 2000 (see http://www.frame-online.net/library.htm)

[4] World Bank, *ITS toolkit for road transport in countries with developing and transitional economies*

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