WHY DO YOU NEED AN ITS ARCHITECTURE EUROPEAN AND NATIONAL PERSPECTIVES

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ABSTRACT

ITS is becoming more complex and difficult to produce and deploy successfully. One way of alleviating this situation is to create an ITS Architecture. This provides a top-level framework that contains the minimum top-level assumptions necessary. Once created, an ITS Architecture can be used to produce a variety of management products to guide the future ITS deployment. An architectural approach provides benefits for the ITS Stakeholders, with End Users, Authorities and Operators as well as Manufacturers and Suppliers all gaining from a long term planned approach. An ITS deployment without an Architecture is likely to be a "technology island" with no links, and little in common, with the other "islands". A growing number of European nations are now creating their own ITS Architectures, based on the KAREN/FRAME Architecture, which will assist them to provide ITS services.

INTRODUCTION

As technology continues to advance and develop, the systems into which it is built are becoming increasingly complex. In addition the expectations of stakeholders (and users) are becoming higher, particularly in terms of system functionality, reliability and the perceived ease with which changes can be incorporated once the system is in use. However, because such systems are now more complex, and require the integration of many components, it is proving to be very difficult to create them successfully.

Integrated ITS brings both advantages and disadvantages. An integrated system should provide greater benefits than those that can be provided by its components acting alone. But in order to achieve such integration it is often necessary to have companies and public authorities co-operating in a manner such that they can both achieve their commercial and pubic service aims respectively. It is also necessary for the various engineering disciplines and manufacturers to work in harmony to create the integrated ITS. This requires effective communication between all the Stakeholders.

System architecture is a technique that can make this communication task much easier. It enables complex ideas to be specified in a manner that is easy to understand so that technical solutions can be identified and critical parts can be highlighted. System Architecture can also enable business opportunities to be identified, system deployments to be planned, and risks to be identified; all in manner that is simple to understand.

WHAT IS A SYSTEM ARCHITECTURE?

Successful integration does not just need agreed communications between systems; it also needs the assumptions underlying the functionality of the systems to be in agreement. A system architecture provides a top-level framework to contain these top-level assumptions. These assumptions must be kept to the minimum necessary to avoid unnecessary constraints on the system development. A system architecture also provides a stable basis for a working (goal oriented functions) and workable (supporting behaviour) system. Since a system architecture states what a system needs to do, rather than how the system will do it, many different specific designs can be developed from one architecture (see Figure 1). These designs can satisfy the demands of specific users or conditions whilst still conforming to the architecture, thus flexible systems may be built on stable architectures.

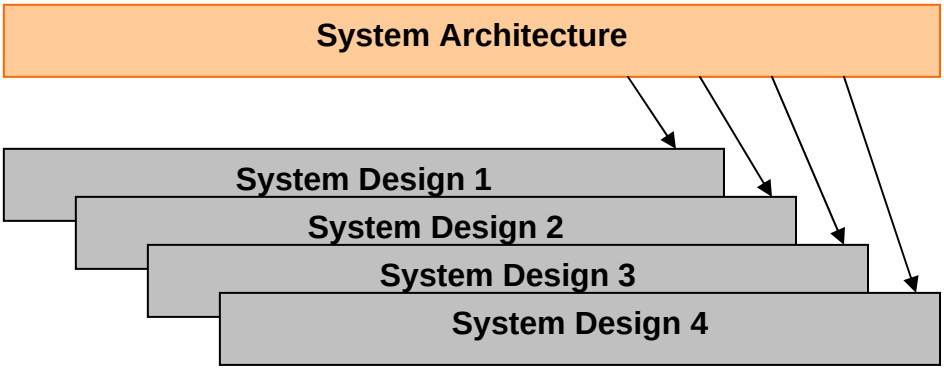

Figure 1 – System Architecture and System Design

An ITS Architecture is a system architecture created for the ITS domain. It is made up of various descriptions of the system that each concentrate on specific sets of features; these are known as "viewpoints" and together they built up a complete description of the ITS. There is no defined set of viewpoints that must exist, but a typical set will include:

- Stakeholders' Viewpoint, often called Stakeholder Needs, or User Needs – these comprise a list of all the functions and features that the ITS will provide.
- Overview, or Conceptual, Model – this provides a top-level description of how everything works together.
- Functional, or Logical, Viewpoint – this shows the processes and data that are required, and how this data flows around the ITS.
- Physical Viewpoint – this shows where the processes will be located.
- Communications Viewpoint – this shows the communication paths that will be needed to pass data between the physical locations.

ITS ARCHITECTURE AS A PLANNING TOOL

An ITS Architecture is created very early in the ITS deployment process, whilst the requirements are being formulated, and before the detailed design of the equipment (see Figure 2). It is the tool that can be used for long term strategic planning, for the creation of annual plans, and for the high-level specification of specific projects. Its use in the early

stages of the deployment permits many potential problems to be highlighted and then resolved quickly and cheaply.

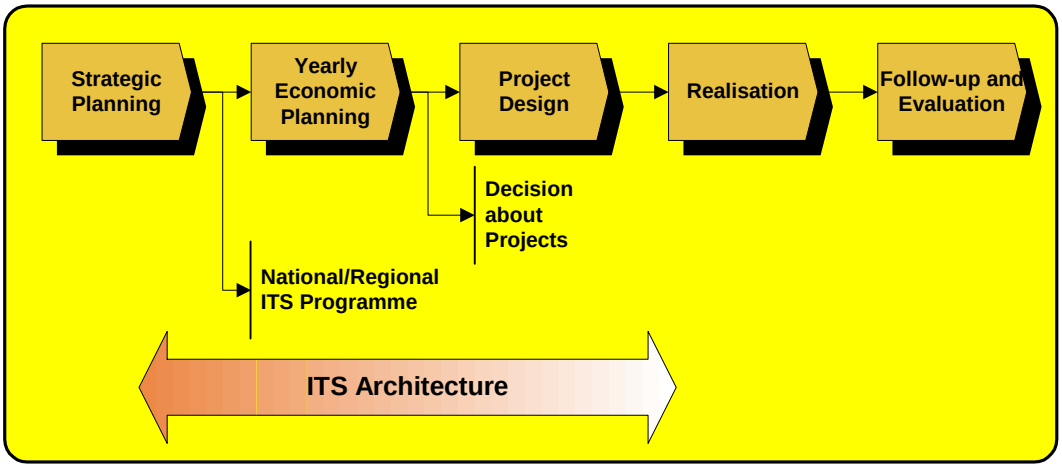

Figure 2 - ITS Architecture in the ITS deployment process

Once the various viewpoints listed above have been created, an ITS Architecture can be used to create a number of management products (see Figure 3). The Organisational Viewpoint and Deployment Programme are part of the long term Strategic Plan and are used to create the Yearly Economic Plans. Different potential solutions can be compared using Cost Benefit Analysis and Risk Analysis. Once the content and scope of an ITS deployment within the plans has been determined, the Infrastructure and Component Specifications can be used in Calls for Tender for its implementation.

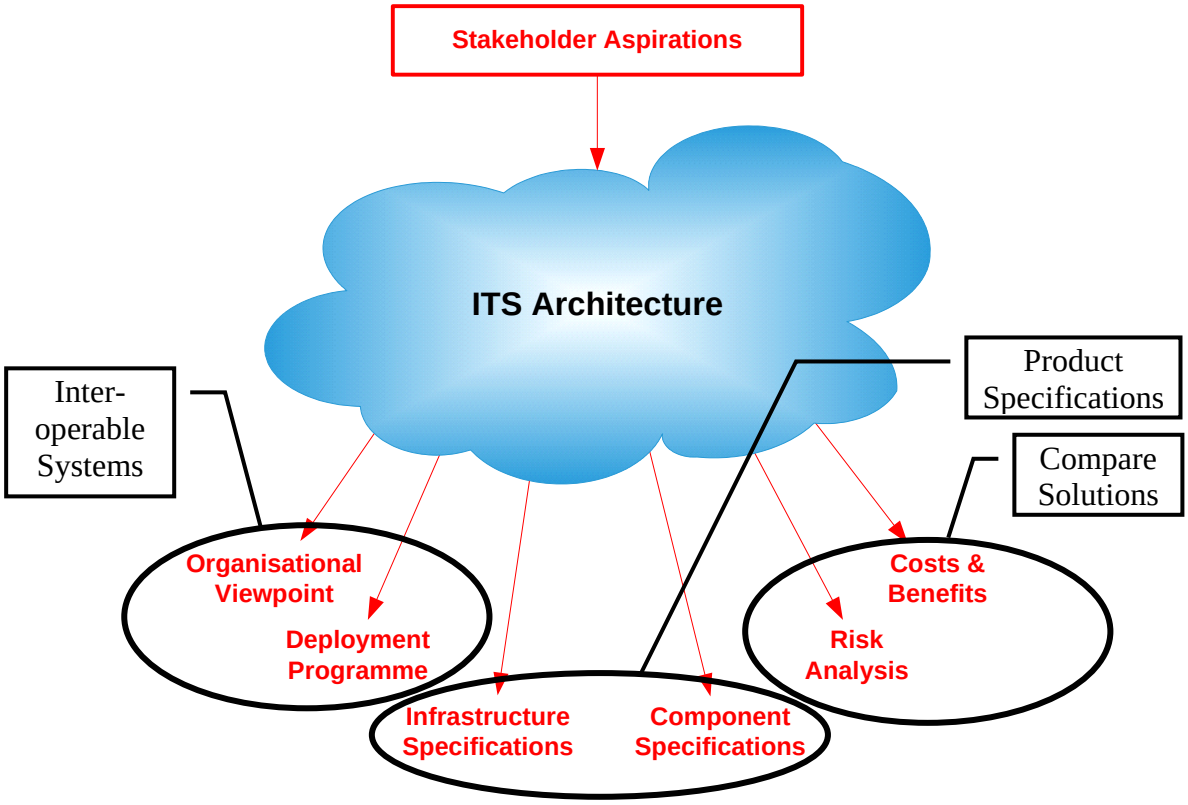

Figure 3 – Uses of an ITS Architecture

BENEFITS OF USING, AND RISKS OF NOT USING, AN ITS ARCHITECTURE

An architectural approach provides benefits for a variety of ITS Stakeholders. For example, End Users see a planned approach where compatible equipment works everywhere and in the same way. Authorities and Operators get a technology independent plan which enables long term investment to be applied: they also see an open market with Standards, multiple sources of supply and hence lower costs. Suppliers and Manufacturers also see a long term planned approach and therefore low risk investment: open systems with Standards result in a large market place, economies of scale and higher profits. Many different types of supplier are possible, including Small and Medium sized Enterprises (SMEs). Thus an ITS Architecture:

- Provides common understanding and assumptions across all components.
- Permits technology to change without wholesale component replacement;
- Facilitates consistency of information across all components;
- Facilitates inter-operability of components;
- Facilitates an open market with many participating suppliers;
- Permits economies of scale from component re-use;
- Encourages investment by developers and users;

If no ITS Architecture is created then, initially, few problems will be encountered. However, as the pressures increase for more services to be added, and the need to integrate with adjacent systems becomes essential, then the difficulties will start to appear. Not only may the communications interfaces of the various systems be different, but also the assumptions underlying their functionality will be incompatible at varying degrees. Stakeholders, however, will expect the ITS to work properly with all services, and across several modes. Without an ITS Architecture the costs involved in achieving this may be very high, indeed many systems may have to be replaced in order to get it right; i.e. there will be:

- A lack of coherent component integration;
- No appreciation of the risks to deployment and operation;
- Difficulty in extending the services provided;
- Difficulty in adapting to new technologies;
- Higher costs for component ownership;
- A failure to develop the full potential of the system deployment.

One way of summing up these risks is to say that without ITS Architectures, the systems and components included in ITS deployments are at risk of becoming “Technological Islands”. Like many islands they will have no links with anything around them and have little in common with other islands.

EUROPEAN AND NATIONAL PERSPECTIVES

ITS Architecture activities are taking place in many countries throughout the world. In Europe the KAREN project created the European ITS Framework Architecture, which is being maintained by the FRAME projects. A number of countries are beginning to use it as the basis for their own national ITS architectures, with France (ACTIF) and Italy (ARTIST) being the most advanced, and Austria (TTS-A) close behind.

The methodology used by KAREN/FRAME is not the only one possible, and Norway, Finland and The Netherlands have each produced their ARKTRANS, TelemArk and TMA ITS Architectures respectively using a different set of processes. One of the reasons for Finland and The Netherlands not using the KAREN methodology was that they started work before the KAREN project had produced any useful results. However, whilst their development processes might be different, all these nations are very keen to ensure that their results are compatible with the European ITS Framework Architecture.

A growing number of other European nations are now wishing to have their own ITS Architectures and they are all starting from, or are planning to start from, the European ITS Framework Architecture. There are three principal reasons for this:

- Cost – although each nation state is different from the others in a number of respects, there are also many similarities, especially when cross-border transport services are being considered. The FRAME project estimates that the European ITS Framework Architecture should normally provide about 80% of any national ITS Architecture. Thus, by starting from this basis, a considerable amount of work does not have to be repeated, thereby reducing the cost.

- Compatibility and Communication – A national ITS Architecture is compatible with the European ITS Framework Architecture provided it uses the same elements for the same things. Thus, in addition to providing a common approach between regions and cities, if all national ITS Architectures are compatible with the European ITS Framework Architecture, it should be easy for the nations to communicate with each other as they plan their trans-national transport services.

- Knowledge Pool – By using a common starting point and development methodology, those creating ITS Architectures can call upon a large body of experience and knowledge to help them in their task. This experience and knowledge is currently manifested through the services provided by the FRAME projects.

In order to reap these benefits it will be essential for the European ITS Framework Architecture to be maintained, and for advice on its use to continue to be readily available. At the time of writing discussions are taking place with the European Commission as to how this may happen after the FRAME projects have finished.

CONCLUSIONS

An ITS Architecture is a top-level framework, and a strategic plan for the design and deployment of ITS services. The existence of an ITS Architecture provides a number of benefits, in particular:

- Technical
  - Facilitates component inter-operability;
  - Facilitates consistency of information: sharing of data;
  - Permits technology integration: easy upgrades;
  - Problems can be identified and solved at less cost.
- End Users
  - Seamless working of integrated transport services.
- Business
  - Provides an open market for services and equipment;
  - Permits economies of scale.
- Political
  - Encourages investment.
- All
  - Provides a common understanding;
  - Enables better planning of ITS deployments.

Meanwhile the lack of an ITS Architecture is likely to lead to:

- Higher costs when upgrading equipment;
- Limitations on the ITS services that can be provided;
- A lack of system inter-operability;

which can be summarised as being a failure to use the ITS components fully and effectively, and the cost of fixing these problems could be very great indeed.

An ever increasing number of countries are recognising the benefit of having an ITS Architecture, and of basing it on the European ITS Framework Architecture.

ACKNOWLEDGEMENTS

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